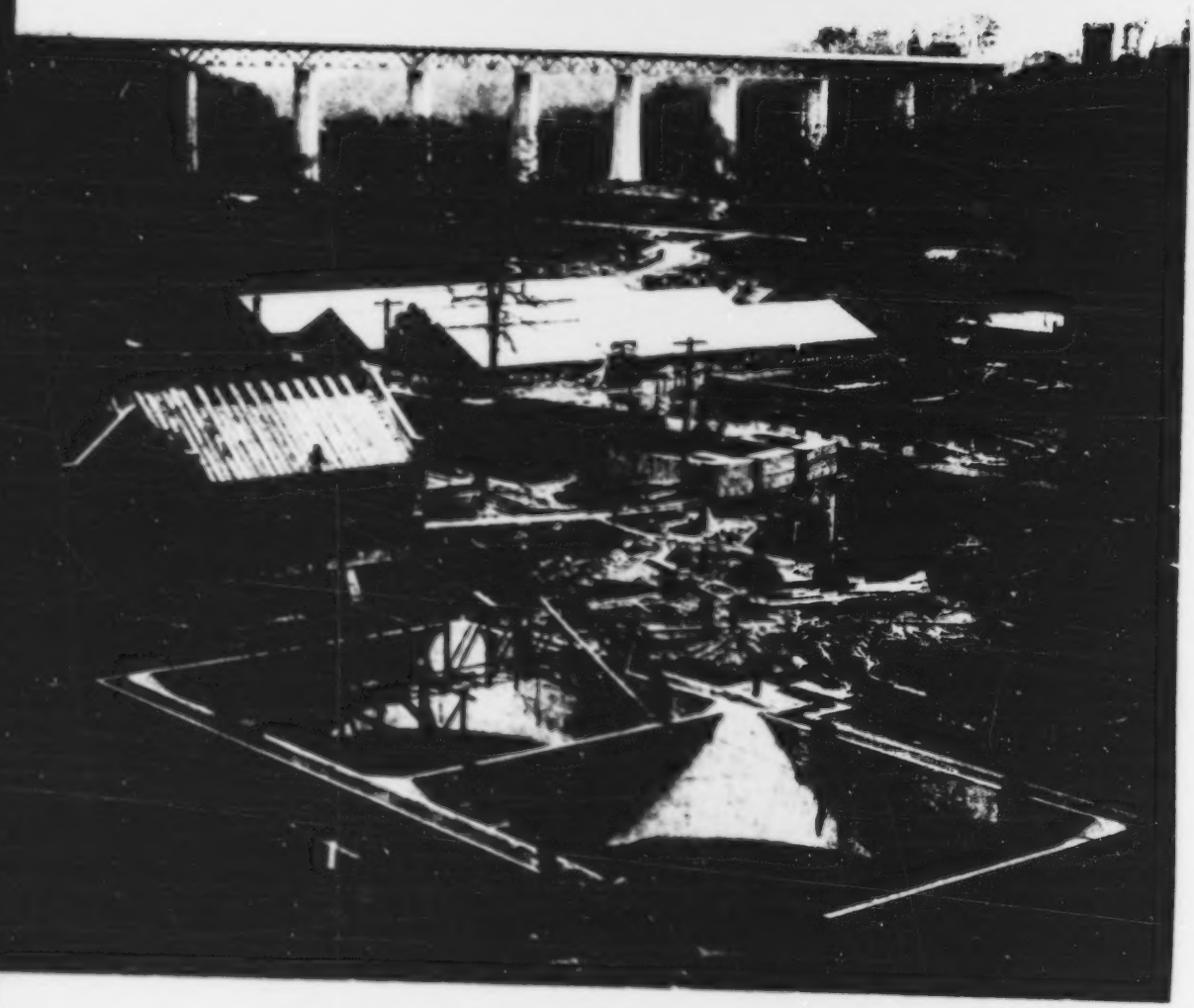
Recollections
Water Pollution Control in Ontario



POLLUTION CONTROL ASSOCIATION OF ONTARIO

RECOLLECTIONS OF WATER POLLUTION CONTROL IN ONTARIO

Pollution Control Association of Ontario
Aurora, Ontario

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1894 - 1984

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FOREWORD

RECOLLECTIONS FROM THE PAST

It has been said that the study of our past is perhaps, the best way to anticipate the future. **Recollections** was commissioned by the Pollution Control Association of Ontario and, while our research has revealed a wealth of information which might have been lost to posterity had the project not been started, we are well aware that the book contains many omissions. While we made protracted efforts to fill in the gaps by mailing requests and placing notices in the trade press, some areas remain incomplete.

The data clearly show that the early years in Canada's development produced some outstanding Canadian engineers to meet the challenges of contaminated drinking water and primitive disposal methods. The outstanding contributions of men like Willis Chipman and Albert Edward Berry were revealed as our research unfolded. Dr. Berry died at the age of 90, as the final chapters were being proofed, after a lifetime of service.

While many of the formidable problems which faced the early pioneers have long been overcome, by research, development and by what can now be considered traditional engineering, new challenges such as toxic and hazardous waste treatment and disposal face today's engineers. The solutions to these problems will also require continued research, development and the application of innovative engineering and technologies.

Recollections represents a most ambitious project which was undertaken on a very limited budget. While we acknowledge that the work is incomplete in some areas, **Recollections** nevertheless contains a wealth of information about our engineering pioneers, consulting engineers, government agencies, universities and equipment suppliers which cannot be found in any other single source.

T. D. Fahlenbock
1984-85 President
Pollution Control Association of Ontario

February, 1985

PREFACE

Many dedicated people gave freely of their time and energies before this book was translated from an idea into reality. The idea of such a project had often been mooted, but it was not until the PCAO's History Committee, consisting of Peter Laughton (chairman), Grant Mills, Sid Dutton, Ron Mondoux, and Mel Holenski, was formed that the project was started.

Peter and the committee were tireless in promoting the idea, and obtaining the necessary funding for the project. They felt that Ontario had contributed a great deal to advancing the state-of-the-art in environmental protection. If it were not recorded soon, Peter argued persistently, key figures would pass on and vital records and achievements would be lost forever. Without his and the committee's unbounded enthusiasm, this published work would still be little more than a desirable project. Special mention must also be made of Ms. Sheila Ritchie, of Anderson Associates, whose patience and word processing skills became increasingly apparent over innumerable revisions.

The book has no single author; we drew from diverse reports and papers such as the excellent historical work by Mr. Douglas McCarthy. Both Mr. McCarthy, and his father before him, were engineers and City of Toronto employees. Other data sources included Environment Canada papers and reports by MacLaren Engineers on the development of Metro Toronto.

We are also greatly indebted to the many individuals who read and commented on the drafts for this book.

Tom Davey edited most, but not all of the papers and wrote the sections on Ontario's Engineering Heritage, the Evolution of Professional Associations and the sections on Dr. Berry and Geoff Scott. Sandra Davey did much of the copy editing and assembly of data which arrived as the book was going to press.

Don Redfern, Chairman of the Proctor & Redfern Group, provided invaluable data, including a paper by his father, the late W. B. Redfern, which meticulously recorded all Ontario treatment plants in operation by 1936. C. S. Dutton researched additional material which proved historically significant.

Frank Horgan, Metro Toronto Works Commissioner, and W. L. Keay, former Director of Pollution Control, Regional Municipality of Ottawa-Carleton, both unearthed records which revealed that engineers and scientists were deeply involved in environmental protection many decades ago. Bob Ferguson, of Metro Toronto, along with his staff, was very helpful in providing data on Dr. A. E. Berry. Some very early reports display a lucid understanding of the complex problems associated with wastewater treatment and environmental protection.

We have been greatly assisted also by George Crawford, George Powell and Les Smith of Gore and Storrie Limited. We drew heavily from that company's publication, "A Perspective On The Development of Consulting Engineering In Canada".

Gerald Nunn, Publisher of Water & Pollution Control, also assisted by providing valuable data, photographs and other resources from his magazine's records. Interestingly, W&PC celebrated its 90th Anniversary in 1983 and valuable historical data was unearthed when the publication researched a commemorative issue that year. The magazine, formerly the Canadian Engineer, carried articles about engineering pioneers such as the Keefer brothers, Willis Chipman and Dr. Albert Edward Berry.

Drs. Gary Heinke, Philip Jones and Glynn Henry, of the University of Toronto's Department of Civil Engineering, also provided data.

The Communications Branch at the Ontario Ministry of the Environment was also helpful - providing material such as "The OWRC Saga" from which we have excerpted both verbatim and edited sections. We most gratefully acknowledge the generous and unconditional support of the Ontario Ministry of the Environment.

Some of the older consulting firms had already documented much historical data and the availability of material from such sources gives some imbalance which we strove, not always successfully, to correct.

We hope someone will do a larger, more complete book later, perhaps as an academic thesis, as we feel there are many significant environmental data still hidden and in danger of being lost forever.

We have dwelt only on the development of wastewater collection and treatment schemes, while highlighting some of the outstanding engineering and scientific figures. As pioneer canal building was a direct precursor of environmental engineering, and sometimes part of the careers of outstanding pioneer engineering figures, we have included data from these historic Ontario projects, many of which are fascinating in themselves. We found much valuable data in Dr. Robert F. Legget's publications, including: "The first 150 years of Civil Engineering in Canada". Dr. Legget is unquestionably the dean of Canadian engineering historians and the country and the profession owe him a great debt.

The records show that beach and urban pollution was frequently a life-threatening issue long before the turn of the Century and that Ontario responded to the challenges with an energy, expertise and massive capital spending which is internationally renowned while, paradoxically, being ignored at home.

In cases where modesty threatened the exclusion of relevant data, projects or awards, such objections were ignored. As this is a project by the Pollution Control Association of Ontario, the book includes recollections and photographs of PCAO activities and those of its predecessor, the Canadian Institute on Pollution Control. This is a 'family album' of Ontario's professional pollution abatement fraternity, as well as a technical record of early or significant projects.

CHAPTER ONE

ONTARIO AND ITS ENGINEERING HERITAGE

No country on earth is as fortunate as Canada in its water resources. The huge land mass sparkles from coast to coast with an unmatched array of lakes and rivers. No Province can match Ontario's fresh water riches. The only Province fronting the Great Lakes, Ontario has such masterpieces as Niagara Falls, a large stretch of the mighty St. Lawrence River and some hundreds of thousands of lakes within its borders.

But, in spite of these lavish natural endowments, sickness, death and misery were too often prevalent in Ontario before water and sewage treatment facilities were installed.

Ontario, however, was doubly fortunate. The Province was not only blessed with abundant water resources but it was lucky enough to produce some outstanding sons, who were not only pioneer engineers but also environmentalists, decades ahead of their time.

According to Dr. Robert Legget, the dean of Canadian engineering historians, the debt that Canada owes to the Corps of Royal Engineers (of Great Britain) and to a minor degree, to the Royal Staff Corps, has yet to be fully recognized. Probably the first significant engineering works, apart from military fortifications, were small locks built in the late 1700's by The Royal Engineers around rapids in the Soulanges section of the St. Lawrence River. A driving force behind building the early military canal and fortifications was the first Duke of Wellington, who was concerned with the defences of North America against possible invasion from the United States. In 1814, the Iron Duke was urged by the British Government to leave Paris and take command of the British forces in North America for the final phase of the War of 1812, which was still unresolved. As Dr. Legget phrases it in his University of Toronto Sesquicentennial lecture 'The First 150 Years of Civil Engineering in Canada': "Fortunately for the world, he refused and so was available to defeat Napoleon at Waterloo."

Dr. Legget reveals a little known fact about the Iron Duke. He had historic links with what became the University of Toronto, which endure today and still benefit students at the University. In the Duke's autumn years, one of his sons sent him a report on the Rideau and Ottawa River Canals. Dr. Legget writes that the Duke had both a military (for defence) and financial interest in the Welland Canal Company. Later when this company was bought out, the Duke arranged for his share to be placed in a Trust, to be used for scholarships at King's College. Later King's College became the University. Trinity College was established in 1851 and acquired the trust fund. Every year since then, two Wellington Scholarships have been awarded. Dr. Legget asks in his paper, "how many of the recipients know the connection between their awards and the early civil engineering work in Canada?"

In 1819, three small canals were built on the Ottawa River near the site of present-day Ottawa. A few years later, in a construction period of six summers, Lieutenant Colonel John By built the Rideau Canal with its numerous locks and channels, between Ottawa and Kingston. Dr. Legget notes that "to build a 123 mile waterway, using rivers and lakes, with 47 masonry locks and over 50 dams (one a masonry arched dam over 60 feet

high) in six summer working seasons, would be a memorable achievement even today with all the aids of modern construction. John By did this between 1827 and 1832 in virgin forest with no construction equipment at all, other than men, shovels, wheelbarrows and small hand winches for lifting heavy weights. The Rideau Canal stands today as an epic example of early civil engineering in Canada." When Colonel By was summoned to England, however, he received no praise for his tremendous achievement. Instead he was censured for exceeding the cost estimates of the canal.

The records reveal that the development of such public works projects produced a fraternity of eminent engineers, and prominent amongst them were some towering figures in environmental engineering.

Many played a major role in establishing the professional associations which endure today. Some of the data are tantalizingly inadequate, yet repeatedly there is evidence of a succession of remarkable men and outstanding engineering accomplishments.

For example, when Sir Charles Lyell, the famous British geologist, visited Toronto in 1842, he was met by 'Thomas Roy, the Civil Engineer' who, according to Dr. Legget, proceeded to show Sir Charles the raised beaches of Lake Ontario, about which Mr. Roy had presented a stimulating paper to the Geological Society of London, in 1837. Regrettably, Dr. Legget says only scraps of information about Mr. Roy can be found. He lived in Toronto from 1834 until 1842 when he died soon after greeting Sir Charles. His brief obituary records that, "he not only planned (but) carried out into execution the various public improvements which have raised this city to its present state of prosperity." In 1841, he published a pamphlet on "The Principles and Practice of Road Making", and as one of the early road builders of Toronto he would have planned some of the drainage schemes which inevitably accompany road works. But, if details about figures such as Mr. Roy are scant, we are fortunate that a wealth of data is available for some other key figures; indeed some of their works are still in existence.

The Keefer brothers, born in Thorold, must be numbered among Ontario's most remarkable sons. Samuel Keefer, (1811-1890) worked on the first Welland Canal. He became an eminent public works engineer. At the age of 30, he was appointed to the highest engineering position in Canada, the first chief engineer of the Board of Public Works of the United Provinces. He designed one of the pioneering link suspension bridges of North America which was built in 1836 across part of the Chaudriere Falls on the Ottawa River.

His half brother, Thomas Coltrin Keefer (1821-1915) designed several of Canada's urban water supply systems in his long and busy life. Like many engineers who would follow them, the Keefer brothers were active in professional associations. In 1886, the Keefer brothers met in Ottawa City Hall with Sir Casimir Gzowski and other leading engineers in Canada, including Robert Surtees, Ottawa City Enginer, to discuss the formation of a national society. The main purpose was the creation of a body which would co-ordinate the activities of engineers in all parts of the new Dominion. In 1887, the Canadian Society of Civil Engineers was established, with head offices in Montreal. Thomas was elected the first President of the New Society. Two years later, Samuel was elected to the same high post.

In 1888, Thomas Keefer was appointed President of the American Society of Civil Engineers, the first Canadian to be so honoured. More than 75 years would pass before another Canadian would achieve that high office. In 1898, Thomas was elected President of the Royal Society of Canada. In 1918, the Canadian Society of Civil Engineers, by Act of Parliament, changed its name to the Engineering Institute of Canada.

An examination of historical records also reveals the extraordinary Willis Chipman as a giant in Canada's environmental progress. Although his family could trace its roots in England right back to William the Conqueror's times, both he, and his father before him, were born in Ontario. After schooling at Athens and Weston, Ontario, he later graduated from McGill University with first rank honours in Civil and Mechanical Engineering. As surveying was an important profession in the then developing Canada, he obtained both Dominion and Ontario land surveying commissions in 1881. He went on to earn a Canada-wide reputation for his water and wastewater treatment plants. The interest in surveying bears some explanation.

Over a century ago, many of the land surveyors, who had a talent or interest in hydraulics and other engineering disciplines, developed engineering expertise. Indeed, some added C.E. to their names, along with other qualifications such as DLS or OLS. In a 60th Anniversary publication, "A perspective on the development of Consulting Engineering in Canada", Gore & Storrie Limited states: "Substantial recognition must be given to the land surveyors of 100 years ago. It is evident that many early engineering works were accomplished by those land surveyors....."

This evolution from land surveying to engineering is probably not surprising when one considers that the original Survey's Act in Ontario is dated 1796. Provincial associations of land surveyors were formed in Manitoba in 1880 and in Ontario in 1886.

Willis Chipman was a founding member of the Association of Ontario Land Surveyors. Ten years later, he served as its President. He was also a prominent member of the Engineering Institute of Canada and one of the most active members of the committee which drew up the Bill creating the Association of Professional Engineers of Ontario. He became the second President of the Association in 1923.

Commencing during the early 1890's, Mr. Chipman's record in the design of sewerage systems and treatment plants throughout Canada was remarkable. He is credited by Gore & Storrie's "Perspective" as the originator of the separate system for sanitary and storm water sewers in Canada. He laid out some of the original Brockville, Ontario sewers and published several articles in the Canadian Engineer which began in 1893. (After several name changes, the magazine is published today as Water & Pollution Control).

Mr. Chipman's articles for this magazine include: London Sewerage System, Oakville Waterworks Auxiliary, and Ontario Waterworks System. In the Proceedings, Canadian Society of Civil Engineers, published about the same time, he has a paper entitled "The Separate System of Sewerage and Storm Water Draining".

In 1901, he joined forces with Mr. George H. Power and began a consulting partnership under the name of Chipman and Power. More about this pioneering firm can be found in the Chapter: **The Consultant's Role.**

In his quest to further advance the state-of-the-art, Mr. Chipman visited the New England States in 1885, to inspect and study waterworks and sewerage problems; and in February and March, 1900, he studied waterworks, sewerage and sewage disposal systems in England and Scotland. In 1891, he made a study of the sanitary systems in Denver, Seattle and San Francisco.

When Willis Chipman died in 1929, he was interred in his family plot at Brockville. Fittingly, his iron ring denoting "The Calling of an Engineer" was buried with him. While many of his projects have become obsolete with the passage of the years, Willis Chipman left an enduring legacy in the form of a cleaner environment and a marked advance in the state-of-the-art.

At the turn of the century, all trunk sewers in the City of Toronto discharged directly into Lake Ontario, or into streams which discharged into the lake. For now obvious reasons, this was both unsatisfactory and unhealthy, although in that era, many believed that sewage was stabilized over time when flowing through sewers. In 1909, a new system was begun. Two 'interceptor' sewers were constructed across the city on an east-west line, connecting with other lines already in service. Sewage was diverted into sedimentation (Imhoff) tanks, at Ashbridge's Bay in Toronto's east end. This system was completed in 1913 during the first year of the legendary R. C. Harris' term as Works Commissioner. The remainder of the sewer system consisted of lines built in the city since 1835, along with other sewer systems which had been inherited piecemeal, as various municipalities and townships were annexed, beginning in 1883.

Roland Caldwell Harris, famous for his ever-present cigars, was not an engineer by profession, yet he proved to be instrumental in the design and construction of massive public works upon which he left his unmistakable stamp. Born in 1875, Mr. Harris began work as an office boy for the City of Toronto at the age of 12. Clearly he had little formal education, yet a year later he worked as a night office boy for the Toronto World newspaper. Later that year, he began as a cub reporter for another Toronto newspaper, the News. His career shifted several times and he worked as a clerk for a real estate broker and a bank for a few years.

In 1899, he was listed as an electrician in the City Directory, apparently learning this trade at technical school. While not an educated man in the formal sense, he was an avid reader of technical journals and in 1899, he accepted a position as a clerk in the City Commissioner's Department. After various promotions, he was appointed to the combined position of City Engineer and Commissioner of Public Works on June 10, 1912, following the resignation of Charles Rust.

R. C. Harris took over during the dramatic growth in the first quarter of the 20th Century when the City doubled in both size and population. The population grew from 199,043 in 1900, to 410,036 in 12 years. People came to demand smooth roads, safe drinking water and an efficient sewerage system and he was responsible for the many public works which

took place during the unprecedented growth. He focussed much of his attention on the continued expansion of the network of sewers to the city limits, much of the expansion being accomplished between 1913 and 1925. From 1924 to 1930, emphasis was placed on servicing the new land created south of the railway lines, as the Lake Ontario shoreline was extended southward by hydraulic dredging.

Two projects related to wastewater treatment are singled out in "The Architecture of Public Works", published by the city in 1952; 'the Garrison Creek relief sewer at Strachan Avenue', built in 1924, and 'the Leaside Disposal Works', completed in 1929, the latter better known as the North Toronto treatment plant. This plant was also the first activated sludge plant in the city and is mentioned elsewhere in the book, because of its technical significance.

As early as 1927, the need for a more advanced sewage treatment plant at Ashbridge's Bay was seriously discussed. Some stormy scenes took place, including litigation, before construction of today's Main Treatment Plant was begun during Mr. Harris' term of office. At the age of 70, R. C. Harris died of a heart attack on September 2, 1945. He had not taken a holiday for six years because he felt a responsibility to contribute to the war effort. He had presided over the City's most spectacular boom, leaving his indelible mark upon it.

R. C. Harris was succeeded as City Engineer of Toronto by Mr. George G. Powell.

Leslie R. Allan was Works Commissioner for the city, when Metropolitan Toronto became an entity on January 1, 1954. He became the first Commissioner of Works for Metro Toronto. When Harvey Rose, who was Roads Commissioner died in 1954, Mr. Allan became Commissioner of Works and Roads, with responsibility for roads, sewage and water treatment. Very soon, however, the need to separate these two bodies was recognized and Ross L. Clark was appointed the Commissioner of Works in 1956 with responsibility for Metro water, sewage, garbage and air pollution works.

Preparation of the Metropolitan Toronto Act, initiated by the Ontario Cabinet, was overseen by Mr. Lorne Cumming of the Ontario Municipal Board, ably assisted by Mr. William Storrie, the latter providing input in the areas of the Act having to do with water and sewage works. Fred Gardiner, formerly an alderman in Forest Hill Village, became the obvious candidate to be the first Chairman of the Metropolitan Toronto Corporation. He combined great political skill and leadership in implementing the Metropolitan Toronto Act and led the, then, thirteen communities involved through the growing pains which began on January 1, 1954.

If Fred Gardiner used his consummate political skills to maintain order in a new political wilderness, it was Ross Clark who presided over the equally difficult engineering task of providing services for the newly-formed metropolitan area. Appointed at age 43, after some 10 years in the City and Metro Works departments, Ross Clark brought sound engineering principles, RCAF experience dealing with men, an athletic background at the University of Toronto and very considerable energy to the Commissioner of Works position. He combined engineering excellence with political awareness.

Throughout the initial accelerated capital program of the 1950's and 60's, and for some 25 years, Ross maintained a demanding pace, commensurate with Metro's growth. At the same time, he successfully melded the engineering teams of his own department, area municipality engineers, consulting engineers, and contractors, as well as the councils which had to approve budgets and projects.

Indeed, Fred Gardiner repeatedly stressed that, more than any other person, Ross Clark made the metropolitan concept a successful reality.

Ross Clark in his time was president of the Canadian Institute on Pollution Control and received the Water Pollution Control Federation's Bedell Award. Additionally, he was a most active member of the American Public Works Association, helping initiate the Ontario Chapter and, in 1970, being elected president of the parent APWA body, a rare honour for a non-American. For some years he was the APWA's trustee as one of the ten member associations represented in the American Academy of Environmental Engineers. The APWA named him "One of the top ten public works officials" shortly after the award was initiated. Another distinction he held was the APEO Engineering Medal.

When Ross retired in 1979 he was honoured at a dinner at the Royal Canadian Yacht Club, given by six Toronto consulting firms. So many distinguished engineers attended that it was said, only half jokingly, that if the launch were to sink, Canadian engineering would be set back for years. A formal retirement dinner at the Sheraton Hotel in Toronto saw over 600 politicians, municipal officials, and friends honouring Mr. Clark.

Ross Clark was succeeded by Frank Horgan. While R. C. Harris and Ross Clark faced their own different challenges with great skill, Frank Horgan faces new pressures, in the full light of the electronic media, from various eloquent, well-informed, pressure groups. He has responded with skill and restraint, while also continuing the modernization and upgrading of the country's largest and most sophisticated sewerage system, as well as attending to Metro's water treatment processes, refuse disposal and other vital civic services. Frank Horgan is proving an able successor to his illustrious predecessors. His peers in the American Public Works Association honoured him in April 1984 as "one of the top ten best public works officials in North America", currently titled "Public Works Leader Of The Year".

Looking through the historical data, we found little evidence of involvement by women. In the University of Toronto graduation photo for the degree of Bachelor of Applied Science, only one female face relieves the rows and rows of male hopefuls in the class of 1912. A Miss H. E. Scott gained her degree then, but apart from her striking photo, we have no record of her later work. We can only imagine the difficulties she encountered getting a science degree in those days, not to mention a career in the learned professions.

While most of the pioneering work was done by men, a situation regrettably echoed in many fields until recently, it is worthy of note that some outstanding female engineers and scientists have made their mark in recent years. Ladies such as Mrs. Ann Vajdic of Environment Ontario, or Drs. Pam Stokes and Anne Whyte of the University of Toronto's Institute for Environmental Studies, are among the growing number of women now making their mark through their research and papers

on a wide variety of environmental topics. In July, 1984, Dr. Stokes became Director of the Institute, the first woman ever appointed to this important post.

CHAPTER TWO

THE EARLY DAYS AND THE EVOLUTION OF TREATMENT PLANTS

In 1853, the Toronto newspaper 'Patriot' complained of pollution of the bay and the contamination of ice which was harvested for domestic use. In 1886, Toronto city fathers, concerned about typhoid epidemics, hired specialists to investigate the water supply, while other experts studied sewerage problems. In its early years, Ottawa too, was plagued with typhoid and other water-borne diseases. Even as late as 1910, deaths from typhoid and the level of infant deaths were astronomical. Dr. A. B. Moffat, of the Department of Health of the City of Toronto, reported a drop in typhoid fever deaths per 100,000 population from 44.2 to 0.9 from 1910 to 1928. In the same years, the infant mortality rate per 1000 live births dropped from 139.2 to 60.3. This, he attributed in part to chlorination beginning in 1910 and pasteurization of milk. He said, "the Toronto citizen now accepts his safe water, milk and food supply without much thought as to how it came to be safe or what efforts are required to keep it so". Typhoid was only one of the diseases which ravaged Ontario communities.

Disinfection of the public water supply in Toronto began in 1910. The records of the 1914 Toronto National Exhibition indicated that some public education was needed to assure the citizens of the day that a little chlorine does a lot. Wallace and Tiernan became the major and almost exclusive manufacturer of gas chlorination equipment, a position they held in the market for forty years or more. Their glass jar vacuum feed machines were in every major and most small water systems in Canada where chlorine was used.

In the mid-1920's, Norman J. Howard, Chemist and Bacteriologist in Charge of Toronto's Filtration Plants, played a significant role in developing super- and de-chlorination.

Wastewater treatment also played a major role in reducing disease. In the late 1800's, most Ontario localities took drinking water from wells and disposed of slops and waste in privies. These privies were emptied from time to time and their contents, "night soil", were used as manure or left to decompose. Cesspools or septic tanks, in which waste could decompose by the action of bacteria, were used rarely.

In large communities, properly constructed and connected sewers were considered to be the best means for the disposal of sewage, but municipalities did not always use the system best suited to their circumstances. Drains and sewers were often improperly built, and water-closets and cesspools were connected to drains unfit to receive and to carry away the contents.

Drains opened into houses and sewage gases were not properly ventilated. Sewers were not laid to proper grade and had to be flushed. Many sewers were, in fact, underground cesspools.

In the water-carriage sewer system, generally established in densely populated areas, sewers were laid at a proper grade to allow quick passage of waste. A sufficient amount of water had to be provided to carry the waste to the sewer outfall. Effluents were generally

discharged into water courses, and the only treatment used was simple dilution. Other treatment methods were known at the time, but were rarely used in Ontario because they were either of dubious effectiveness or too costly. In 1896, a chemical purification treatment system was tried for the first time in Hamilton, but was soon abandoned.

In 1882, the Provincial Health Board was formed in Ontario to advise local health boards. One of the major concerns of the board was typhoid fever. Eighteen persons out of 1,000 suffered from typhoid or similar diseases, and the average mortality rate was much higher than in European cities.

To institute some means of control, the Board gathered information from the United States and from Britain. Britain was, at the time, the leader in the development of sewage disposal methods.

The experiences gained in Europe showed that treatment of municipal water supplies and treatment of sewage wastes could reduce the incidence of typhoid fever. In Frankfurt, Germany, the death rate from typhoid was 8.5 per 10,000 inhabitants in 1856. On completion of a good sewage system, the death rate dropped to 2 per 10,000 inhabitants.

In Ontario, sewage treatment consisted mainly of a dilution of the effluent from the outflow pipes. Aerobic bacteria were expected to decompose the organic matter in the sewage as it dispersed into the receiving waters.

Unfortunately, sewage outfalls often emptied into the same body of water from which drinking water was taken. In Sarnia, for example, the sewage outfall and drinking water intake were only 150 feet apart. In at least one Ontario community, the sewer outfall was located just upstream from the raw water intake.

In Toronto, the first sewer system was built in the 1830's. The contents of some sewers were discharged untreated into Ashbridge's Bay. The Bay became unsightly and a danger to public health. The solution applied to such a problem at that time, was to move the sewage outfall elsewhere.

From 1880 on, sewage systems were built to a greater extent in the large communities. By 1891, they consisted generally of small diameter sewers that excluded all storm and rainwater. They were constructed to be easily inspected and cleaned.

By 1901, Ontario's population had grown to 2.2 million. Sewage treatment had become more important than ever before, but its introduction ran into strong opposition. Municipalities situated on the shores of the Great Lakes baulked at the costs they were expected to incur and refused to treat their sewage until communities on the U.S. shores decided to treat theirs.

During the first decade of this century a number of sewage treatment methods were available to municipalities. Imhoff tanks and filters were used to a minor degree. One fine-screening plant was used in Sudbury for a short time but proved to be not very effective. Sedimentation tanks were popular.

Septic tanks, and a combination of septic tanks with other forms of treatment such as trickling filters, were also popular. Trickling filters, also called percolation systems, were the first biological treatment systems used extensively in Ontario. One of the first ones was installed in Stratford where sewage was first passed through screening chambers and a liquifying tank. It was then sprinkled over a bed of crushed rock, contained in circular open tanks, by pumping through perforated pipes, rotating slowly above the surface of the crushed rock. The rock became coated with slime which consisted of bacteria which fed on the organic matter in the sewage.

Other plants of this type were built in Brampton in 1906, in Guelph in 1909 and in New Toronto in 1913.

Berlin, now Kitchener, not only built a sewage treatment plant in 1912, but also published a most detailed brochure on its official opening to celebrate its elevation to cityhood. The following is a verbatim report from a booklet currently in the possession of Mr. H. Carter, Southwestern Region, Ministry of the Environment. While this has been edited, the technical data have been retained in the appendices:

> "One of the first essays (sic) to solve Berlin's sewage disposal difficulties was to purchase a plot of land of about twenty acres extent. The sewage was made to run from the trunk sewer over beds which were covered and then given time to absorb the sewage. At one time cabbage and sugar beets were grown on the beds and with success. The effluent which percolated through ran into Schneider's creek, on which the old sewer farm is situated. With the passing of time, these beds became choked and unable to perform their function properly. The effluent flowing into the creek became discolored and caused the farmers who lived below the corporation to object. The then town had increased the number of its industries and its population and the old system was too small. Litigation forced the municipality to study the situation and devise a better system of sewage disposal.
>
> Extensive experiments were made by Dr. John A. Amyot, provincial chemist of Ontario, prior to the making of any plans for the work, in order to determine the best methods of purifying the sewage, consistent with reasonable expense for first cost and operation. A series of tests were also conducted at each of the factories to discover if possible methods of excluding from the sewers the most detrimental part of the factory wastes. The experiments with the various types of sewage disposal plants were carried out on comparatively large scales, and showed that proper treatment with septic tanks, followed by filtration through sand, would produce highly satisfactory results, if the more objectionable parts of the factory wastes were excluded.
>
> The septic and storage tanks cost $18,000; the filter beds and their accessories, $20,000; the pump house $1,050, and the machinery, including the electric generator, the two motors and three pumps $6,700.

> Today (1912) from 600,000 to 800,000 gallons of sewage is treated daily. The system of filtration is good and gives off a clear effluent, which fully meets the requirements of the Provincial Board of Health. This is gratifying when it is known that the composition of Berlin sewage is complex and more difficult to treat than ordinary domestic sewage."

This early 1912 report was a valuable record of the treatment facilities and attitudes in vogue at the turn of the century, for the Berlin plant must have been planned a few years prior to the official opening.

In 1916, a Committee on Waters and Water-Powers which appeared to be a creation of the Commission of Conservation Canada published a document titled "Water Works and Sewerage Systems of Canada". A listing of the committee members indicated a cross section of members from Prince Edward Island to British Columbia. Judging from the listing, the members appeared to be men of prominence - "Dr. James W. Robertson, C.M.G., Ottawa, Ontario; Sir Edmund B. Osler, M.P., Toronto, Ontario" to name a few of the Ontario members. This document lists the various sewer systems, treatment facilities (if any) and discharge points for sewerage systems in effect in Ontario at that point in time (1916). Table 2-1 is a listing of towns and cities that were noted to have sewage treatment facilities.

Some of the treatment methods of note pertaining to that era were:

- Hamilton with Emscher tanks and chemical precipitation,
- Oakville with sedimentation tanks and chlorination.
- Orillia with sedimentation and sludge sent to aeration beds,
- North Toronto with Imhoff method with a new sewage system under construction,
- London with sedimentation tanks and coke filter beds.

A search of the Toronto archives revealed that "brush filters" were employed at the North Toronto Plant, with photographs dating their use as early as June, 1916. These "brush filters" may have been what was referred to as a new sewerage system under construction - reference Table 2-1 under "North Toronto System".

The activated sludge process, developed in England, in 1914, by Ardern and Lockett, following research by Fowler, remains the most significant breakthrough in the treatment of wastewaters and a major step in public health and environmental protection. The world's first activated sludge facility began operation in Worcester, England, in April, 1916.

As the activated sludge process was developed only at the beginning of World War I, we tried to trace the first Ontario treatment plant using the new process. The late Ross Clark, in an interview with a researcher for this book, felt that Woodstock constructed the first activated sludge plant in 1921. However, some statements by Dr. Berry also confirm that, while Woodstock was certainly among the first, Brampton, Ontario was probably the first municipality in Canada, perhaps even in North America, to begin construction of an activated sludge facility. In reviewing a draft of this book, Dr. Glynn Henry reflected that Dr.

TABLE 2-1

Sewage Treatment Facilities in Ontario as of 1916

TOWN OR CITY	SEWAGE TREATMENT FACILITY DESCRIPTION
Barrie	"part of sewage treated in sedimentation tanks."
Berlin	"sewage is treated in septic tanks and filtration beds."
Bowmanville	"a disposal plant" - the type is not mentioned.
Brampton	"sewage is treated in a septic tank."
Bridgebury	"sewage treated in septic tank."
Carleton Place	"sewage treated in sedimentation tanks."
Collingwood	"septic tank treatment"
Depot Harbour, Parry Sound District	"sewage treated in septic tank."
Galt	"sewage treated in septic tank."
Guelph	"sewage is treated in septic tank and filtered."
Haileybury	"sewage treated in septic tank."
Hamilton	"the sewage is treated partly by Emscher tanks, partly by chemical precipitation and partly by septic tanks and percolating filters."
Listowel	"sewage treated in a septic tank."
London	"sewage treated in sedimentation tanks and coke filter beds.
Napanee	"sewage treated in filters."
New Liskeard	"sewage treated in septic tank."
North Bay	"sewage treated in septic tank."
Oakville	"sewage treated in sedimentation tank and chlorinated; there are two treatment plants."
Orillia	"sewage only, which is treated by sedimentation, sludge sent to aeration beds."
Oshawa	"sewage treated in sedimentation tanks."
Palmerston	"system is designed for the future installation of septic tanks and filters."
Preston	"sewage treated in septic tank and sand filter."
Rainy River	"sewage treated in septic tanks."
St. Thomas	"sewage is treated in septic tanks."
Simcoe	"sewage treated in filter beds, Imhoff system."
Stratford	"sewage is treated in septic tanks and sprinkling filters."
Sudbury	"sedimentation tanks to be constructed."
Tillsonburg	"sewage is treated in septic tank."
Toronto	"sewage is treated by chlorination and in sedimentation tanks."
North Toronto System	"sewage is treated by a modified Imhoff tank method..... A ne sewerage system is under construction."
Trenton	"sewage treated in sedimentation and septic tanks."
Waterloo	"sewage treated in septic tanks and filter beds."
Weston	"sewage treated in septic tank and on sprinkling beds."
Wiarton	"sewage treated in septic tank."
Wingham	"sewage treated in septic tank."
Woodstock	"sewage is treated in septic tanks and filter beds."

North Toronto "Disposal Works No.1 Brush Filter" July 18, 1916. City of Toronto Archives, Sewers #479.

North Toronto "Sewage disposal Works - Brush Filter Beds and Materials" June 1, 1916. City of Toronto Archives, Sewers #469.

Berry had once referred to Brampton as the place where an activated sludge facility was begun in 1915. Dr. Henry notes that while Houston, Texas had commenced a similar project later, it may well have finished it sooner than Brampton.

Dr. J. J. Ganczarczyk, in his recent book "Activated Sludge, Theory and Practice", lists both Brampton, Ontario, and Houston, Texas, as among the first five activated sludge plants built in North America between 1916 and 1926.

The first plant to use the new process, however, may not have been a municipality, but an Inco wastewater plant at Port Colborne, Ontario. Writing in Engineering and Mining Journal, March 8, 1919, W. L. Wootherspoon, a Consulting Engineer from New York, describes the new International Nickel Company's Refining Works, which were begun in 1916, with a capability of processing 15 million lbs. of nickel, and 8 million lbs. of copper annually. While his article deals mainly with the structure of the buildings and the refining process, the author also wrote that the design of the works provided for a complete power plant, a water supply system, and a separate sewerage scheme. As the article must have been written before the plant was constructed, the Inco plant was certainly among the first to employ the process, if the writer was accurate.

The author wrote that a series of sewers, connecting with large trench ditches excavated through the property, has been arranged with the water finally passing through the sand dunes into Lake Erie.

> "The sanitary pipe service flow is at such a low level that an ejector-chamber pumping station is provided, from which sewage is discharged to a disposal plant situated in the sand dunes. This plant is constructed on the activated sludge process, which provides for the aeration and clarification of sewage, resulting in an effluent free from objectionable matter. This sewage plant is the only one of its kind in the district and was installed on the recommendation of the Provincial Board of Health of Ontario."

While the author does not mention how many workers were employed at the refinery, he did mention that all water was chlorinated, not only the drinking water, but that used in plant operations as well. He mentioned that four change houses, with a total of 600 lockers, had been built with hot and cold showers and lavatory accommodations. Although not specified, it is likely that many more workers were employed at the works than indicated by the 600 lockers, which were probably used on a shift basis, rather than on the personalized locker system common today, as in our high schools. It is interesting to reflect that the writer mentions that "provision must be made for the changing of wet and dirty clothing, and the donning of comfortable and warm street wear." These comments were made as World War I wound to a close. British coal miners, for example, did not get pit head baths and changing facilities until after World War II.

Inco not only appears to have had the first industrial activated sludge plant, it also built several underground sanitary and industrial wastewater facilities which must be among the deepest ever built in Canada. They were designed and built by Inco engineers, with much of the equipment supplied by Envirotech Limited.

Earlier plants also included Woodstock, St. Thomas, Peterborough and Orillia.

During the 1916 to 1921 period, the City of Toronto Health Department conducted two significant experiments under the direction of Dr. Nasmith. These experiments are noted in the 1927 publication (London, England) "The Activated Sludge Process" by A. J. Martin. The first experiment involved the use of what could best be described as rotating contactors with contact-surfaces of interlaced 1 1/2 inch by 3/8 inch builder's lath, mounted on horizontal axles, immersed to a depth of about 40 percent of the diameter, and caused to rotate slowly without disturbance by a small motor. The second experiment entailed the passage of raw sewage through digested sludge followed by aeration and final settling. The inclined settling apparatus was such that "the activated sludge settled out and slipped down again into the aeration compartment." Additional details of these fascinating early experiments are given in Chapter 12.

Dispite the enthusiasm in certain sectors, early progress in wastewater treatment was painfully slow.

The conditions at Cochrane at the turn of the century illustrate the facilities which existed in many Ontario communities. By 1909, there was a commercially operated water pump with a massive padlock, which, for a small fee, would be unlocked so that the citizens could pump their water into pails and carry it back to their homes. There were no sewage disposal facilities. In March, 1923, a typhoid epidemic occurred. It began when a small ditch froze, causing a sewage back-up, leading to contamination of Spring Lake, then the source of the Town's water supply. Some 800 typhoid cases occurred in a population of 2,900. Worse still, cases which occurred as far away as British Columbia and England, were traced to Cochrane because trans-continental trains had taken on ice and water there. By the end of 1923, the town drew its water from newly drilled wells, and, at the same time, began construction of an activated sludge sewage treatment plant. Cochrane, today, is served by modern treatment facilities.

From 1903 to 1913, the typhoid death rate was 24.4 per 100,000 people in Ontario. In Europe, the rate was considerably lower at 8 per 100,000. Typhoid was scattered throughout the province. Ottawa suffered two major outbreaks between 1910 and 1913 and one in 10 persons that contracted the fever in those days died.

To stop the spread of the virulent disease, the Ontario Board of Health was given the responsibility to approve all sewers and watermains. Dr. Albert E. Berry, who joined the Board of Health in 1920, recognized that the incidence of typhoid could only be controlled by the introduction of chlorination of effluent as well as water, and by the pasteurization of milk. As director of the division of sanitary engineering, Dr. Berry worked diligently from 1926 on to promote the use of chlorine. He was also responsible for the introduction of the compulsory pasteurization of milk.

To gather first-hand information, the, then, Ontario Premier, Mitchell Hepburn toured the typhoid ward of the Hospital for Sick Children in Toronto. One visit was enough to persuade him of the need for compulsory pasteurization. Dr. Berry was given the assignment to provide suitable legislation and to enforce it. As subsequent chapters

will show, they chose the right man.

Another important step in the control of pollution of Ontario waters was the formation of the International Joint Commission (IJC) in January 1909, by an agreement between Canada and the U.S. In the agreement, both countries promised to co-operate to protect their boundary waters, principally the Great Lakes, from pollution.

The first major action of the new Commission was the completion of a study designed to determine the extent of pollution in boundary waters. As a pollution indicator, the incidence of coliform bacteria was used. The study, completed in 1912, showed that the water in certain areas of the Great Lakes was dangerously polluted, and that all municipal water supplies were not treated. In the few municipalities that supplied treated water, the treatment was minimal.

Every municipality on the shores of the Great Lakes discharged untreated sewage into the lakes, and the typhoid rate in these municipalities was the highest in Ontario and in the U.S.

The report of the IJC recommended a daily bacteriological examination of drinking water, the treatment of all water supplies and the installation of proper sewage treatment.

In 1928, Ontario experienced more building activity than in any year since 1913. By 1929, there were 95 municipal sewerage systems in operation in Ontario, serving 1,800,000 people. Forty-six systems were equipped with treatment plants; 16 of these plants used sedimentation tanks, nine Imhoff tanks and filters and 19 were activated sludge plants. Plant effluent was not chlorinated.

After a good start in the 20's, the construction of sewage treatment systems decreased in the years 1930 to 1955. During the depression years, the limited funds available to municipalities were generally used to alleviate social problems.

In October 1936, the late **W. B. Redfern**, then Vice President of James, Proctor & Redfern Limited, wrote an extensive report on the state of the art in Ontario. He listed and categorized wastewater treatment plants in operation in the province. His paper divided the plants into three classifications:

1) Complete Treatment Plants, including some type of oxidation process, such as trickling filters, activated sludge, or intermittent sand filters.

2) Partial Treatment Plants, including some type of settling tank.

3) Disposal by dilution where no artificial treatment plant was used.

In 1936, Ontario had 135 municipal sewerage systems, 67 of which were connected to sewage disposal plants. The other 68 municipalities discharged the sewage into receiving waters whose flows were felt to be adequate to receive wastewater in the volumes discharged.

Of the 67 disposal plants, 29 were for preliminary treatment only, and 38 for complete treatment. About 57 percent of the population of Ontario lived in sewered areas and 66 percent of this population was served by disposal plants in the sewered areas. About 38 percent of the total population of the Province was served by disposal plants at the time of the 1936 report.

Mr. Redfern noted:

> "A large industry might very easily contribute as much organic matter to be treated as the total organic matter in the municipal sewage. A tannery waste that came under our observation contained 5000 ppm of total solids. With a flow of 100,000 gals. per day, the population equivalent load was equal to 10,000 people. And this in a town of 2500, of which the sanitary flow equalled 200,000 gals. per day. Trade wastes, from canneries, tanneries, distilleries, creameries, slaughter houses, etc., contain large quantities of organic matter, both animal and vegetable, which go through the same process of decomposition as domestic sewage."

Mr. Redfern described the various processes:

> "There are three types of settling tanks in common use, namely, the plain sedimentation tank; the single-storey septic tank; and the two-storey Imhoff tank. In the plain sedimentation tank, a percentage of the settleable solids in the sewage settles to the bottom and is removed before anaerobic decomposition commences."

The report noted that many two-storey Imhoff tanks had been constructed in the United States and some in Canada, principally in connection with trickling filter plants.

> "The upper storey acts as a settling tank and the lower as a digestion tank. The suspended matter that settles out in the upper storey drops through a slot into the lower compartment. The two compartments are not entirely separated in their functions, but it is a very cleverly designed tank, and these tanks, generally speaking, have given good satisfaction."

Mr. Redfern said that an Imhoff tank, in the Mimico-New Toronto plant, had given good service for more than twenty years.

Chemical precipitation as an intermediate between sedimentation and oxidation became popular in the early 1930's. Chemicals were added to the sewage to coagulate and settle the colloidial matter. With improved facilities for removing the greater volume of sludge produced, Mr. Redfern noted, that there was not the difficulty in connection with chemical precipitation plants that had occurred ten or twenty years earlier. Lime, ferric chloride, ferric and ferrous sulphate and other chemicals were used with good results. Chemical precipitation and sedimentation were necessary for some kinds of industrial wastes before the effluent from the industrial source could be handled by the municipal plant, he wrote.

"For a complete treatment plant, the effluent from a settling tank must be oxidized to reduce the organic matter in fine suspension and in solution, which constitutes at least half the organic matter in sewage. There are three processes in common use for oxidizing sewage, viz., intermittent sand filters, sprinkling or percolating filters, and the activated sludge method. In all three, a biologically active structure or medium in the presence of air is brought into intimate contact with the sewage and oxidation and nitrification follow.

"Intermittent sand filters will produce probably the best effluent with an oxygen demand removal of 90 to 95 percent. Considerable area, preferably in an isolated district, is required for this type of plant as the sand filters have a rated capacity of about 100,000 gals. per acre per day. Before filtration, the sewage should pass through a sedimentation tank to remove the coarse suspended solids. A head of four or five feet is required for the depth of the filters to the under drains. A good example of this type of plant is in operation in Waterloo. A high degree of treatment is required before discharging the effluent into the Grand River. A separate sludge digestion tank forms a part of the installation. Where gravel and sand is readily available, and if the plant can be constructed in an outlying district with sufficient head available where pumping the sewage would not be necessary, the intermittent sand filter plant offers a good and efficient method of treatment for the smaller municipality.

"Many trickling filter plants have been constructed in England and the United States, and a few in Canada. This type of plant produces a clear, stable effluent and is economical in operation. A head varying from 12 to 15 feet is required from the level of the sewage in the preliminary sedimentation tank to the effluent pipe from the final settling or humus tank. If the topography of the disposal site is such that it is not necessary to pump the sewage, and if the site is located in an isolated area, where complete treatment is essential, trickling filters offer a splendid type of disposal plant.

"There have been complaints in some plants about fly nuisance and odours from the spraying nozzles or distributors. In this northern climate, it has been customary to roof over the filters so that the odors emanating from the plant are reduced to a minimum. The usual capacity of filters has been 2,000,000 gals. (U.S.) per acre per day. Recently the New Jersey Health Department 1936 regulations set the capacity for trickling filters for clarified sewage at 630,000 gals. per day per acre foot of filter head. For filters, 6' deep, this would bring the capacity up to 3,000,000 Imperial gals. per acre per day. Sludge drawn from an Imhoff tank in a trickling filter plant has usually been deposited on an open drying bed, and there is practically no odor from such sludge.

"For a small municipality, where complete treatment is required, a trickling filter plant is economical to operate where pumping the sewage is not required to obtain the necessary head. From the point of view of operation, it is preferable to the activated sludge type of plant, but more area is required and the initial cost for a given quantity of sewage to be treated is higher. Personally, where conditions are favourable, I am very partial to this type of plant."

Referring to the activated sludge plant, he noted it was of later development than trickling filters, making rapid strides especially for the larger municipalities. In an activated sludge plant, he wrote, the sewage should receive preliminary sedimentation to remove the coarse suspended matter.

"The sewage is then aerated for a period from 5 to 6 hours being intimately mixed at the same time with about 25 percent by volume of biologically active sludge, which has been created by the same process and is pumped to meet the incoming sewage, after having settled out in the final sedimentation tank. The excess activated sludge is disposed of by pumping to the preliminary sedimentation tank to mix in with the primary sludge before digestion, or is pumped direct to a digestion tank or otherwise disposed of. The airy flocculent nature of the activated sludge being mixed liquor being kept agitated by pumping compressed air into the tank, is very effective in oxidizing and nitrifying the organic matter in the sewage not removed by the preliminary sedimentation tank. If properly operated, this type of plant produces a clear effluent with 90 percent removal of Biochemical Oxygen Demand, and can be discharged without offence into any body of receiving water, no matter how small. The area required for this type of plant is only about one-third the area required for a trickling filter plant. And, if the area available for economic reasons in a municipality for a sewage disposal site is small and congested, and perhaps fairly near a residential section, a covered activated sludge plant for complete treatment offers an excellent method for treating the sewage."

Even in those days the Not In My Backyard Syndrome was present. Although NIMBY was not formally identified as such, Mr. Redfern shrewdly observed:

"The location should be kept as far away as possible from a residential area, because no matter how efficient and free from odours the plant may be, it is still a sewage treatment plant and there will always be sentimental objections. It helps a good deal to plant trees and shrubbery and flower beds around the plant, and to keep the grass looking particularly green from the low-grade fertilizer available."

Then, as now, sludge disposal presented problems. Mr. Redfern wrote:

"The sludge problem in an activated sludge plant is more difficult than other types because activated sludge is bulky and is highly putrescible. Digestion tanks have been installed in a number of plants and the digested sludge run onto sand beds usually enclosed with glass like a green-house.

> In this cold climate in the winter, the glass covers do not work well because the sludge usually freezes and draining and drying is largely at a standstill. Frozen sludge is sometimes removed from the beds to make room for more sludge. When the frozen sludge thaws out in the Spring, it is finely pulverized by virtue of the freezing and thawing operation, and is easily handled, and spread as a low grade fertilizer. But, with the process of draining and drying greatly retarded, sludge tends to accumulate in all sections of the plant where it can be stored with the result that the operator is at his wit's end to know what to do. At the activated sludge plant at Long Branch, a small Oliver vacuum filter has been installed to dewater the sludge from a population in the district served of about 6,000 people. It has one distinct advantage in that it keeps ahead of the sludge, so that it does not accumulate over the winter to make operations difficult. But it requires very careful conditioning with ferric chloride and constant attendance."

Sludge disposal in the larger plants was receiving a good deal of investigation and experimentation. Mr. Redfern wrote of the centrifuge experimental plant at North Toronto,

> "which dewaters primary sludge and activated sludge down to 65 percent moisture, which is then incinerated, has promise of completely and efficiently disposing of the sludge at a reasonable cost without the intermediate and costly facilities of digestion tanks, sludge drying beds, or vacuum filters. But, for the small municipality, the centrifuge is out of the picture yet as the smallest machine made would dispose of the sludge from a population of 20,000 people in about three hours operation per day, or at the rate of 700 pounds dry solids per hour."

Almost 50 years have passed by since Mr. Redfern wrote his excellent paper on the state-of-the-art of the 1930's.

The depression years were followed by World War II which imposed a different set of priorities which resulted in a lack of materials and manpower for non-military uses. This was very evident in the July 1942 contract specifications for the extensions to the St. Thomas Sewage Treatment Plant. The "Special Wartime Conditions" of the specifications stated that:

> "If by reason of any Government agency making or promulgating any regulations after the date of this contract, that prevent the contractor from obtaining any necessary materials or from using materials already obtained, and if in such case the city's engineers are unable to redesign any part or parts of the project so that the said project may be constructed using materials that are available, the City shall pay to the contractor the actual cost of labour and materials used up to the time that the contractor has been permanently prevented from proceeding with the work."

These same "Special Wartime Conditions" also gave direction to the contractor in case the works under the contract were damaged or destroyed by enemy action or acts of enemy agents:

> "If in the opinion of the City Engineer any work herein contracted for and executed or in the course of execution by the contractor is damaged or destroyed by enemy action or the acts of enemy agents or as a result of strikes or disturbances of any kind resulting from war conditions or by factors which could not after proper enquiry have been reasonably foreseen by the contractor, then the contractor shall be reimbursed by the City for any loss sustained by him by reason thereof....."

Later, the escalation of prices prevented municipalities from building new sewage treatment facilities, or from improving the old ones, strained as they were by the growth of population in large centres and the development of industries.

As the growth of cities and of industrial development continued, sewage treatment works were overloaded not only by sewage inflow but also by liquid industrial wastes discharged into the system.

To support municipal sewage and water treatment projects, the Municipal Act, as amended in 1943, allowed municipalities to finance such projects by a user rate rather than from taxes. In 1950, the Municipal Improvement Corporation was established to help municipalities to borrow money for sanitary works at low interest rates.

Despite all the difficulties during the first half of the 20th century, some progress was made. By the end of 1930, 25 of 70 sewage disposal plants provided activated sludge treatment. By 1936, although dilution was still the most frequently used method, 26 plants had activated sludge treatment; nine had trickling filters; 33 had sedimentation tanks and two had fine screening facilities.

In 1943, 70 percent of the population of cities had some form of sewage treatment. Few advances were made until after World War II, although planning for sewage collection and treatment systems was underway in many communities in Ontario. For example, the need for a modern treatment system for the City of Toronto was considered throughout the 1930's, but construction was only commenced during the post-war period and the new modern primary treatment plant placed into operation only by 1950.

From 1946 to 1949, the IJC conducted another study of Great Lakes water quality. At the time, 96 percent of the population of the area had sewers and 86 percent had primary treatment of wastes. Only a small percentage of the communities was served by secondary or activated sludge treatment. Despite the increased number of plants providing primary treatment, the concentration of bacteria in some of the Great Lakes waters was three to four times greater than the concentrations detected in 1912.

At the time of the 1912 IJC study, industrial wastes were of little concern. During the following decades, however, industry spread tremendously. At the time of the 1946-1949 study, the oxygen demand of industrial wastes was equal to the BOD of the untreated sanitary wastes that could be expected from a population of 4 million people. In fact, industrial wastes placed a greater demand on the receiving waters than the combined total sewage produced by the study area population of 3.5 million.

The study recommended the treatment of all municipal wastes by sedimentation and disinfection, the introduction of more efficient secondary sewage treatment and the treatment of industrial waste.

In 1955, 10 new sewage treatment plants were put into operation, making a total of 54 activated sludge, 19 trickling filters and 129 primary treatment plants.

The results of these activities were positive. By 1950, the typhoid death rate had decreased to 2 per 1,000 population.

In 1956, Ontario established its Ontario Water Resources Commission (OWRC) as the first organization of its type in the world. In part, the Commission's mandate was to finance, build, and operate sewage and water treatment facilities in the province. The OWRC is covered more fully in **THE OWRC/MOE SAGA.**

The OWRC's first major project was to change Stratford's trickling filter to an activated sludge system, and to add sludge digestion. Stratford was forced to do this because adjacent townships had complained that the river was so polluted and devoid of oxygen that it was as black as tar. The new plant started operation in 1958.

More financial aids were developed. In 1960, the Federal Government agreed to assist municipalities by financing two-thirds of the costs of a certain portion of sewage treatment works. The funds were administered by the Central Mortgage and Housing Corporation.

The Commission agreed to finance the remaining one-third and sections of sewage works not covered under the federal plan. By 1965, the capital and operating costs of approved municipal projects could be paid for by the OWRC and recovered through service charges to users based on actual usage.

In the late 1960's, the increasing eutrophication of our receiving waters was well recognized and had been studied comprehensively across North America and Europe. Early work by Dr. Clair Sawyer, on Wisconsin lakes near Madison, confirmed the findings of other researchers as to the significance of phosphorus nitrogen ratios in the eutrophication process. In the Madison study, the significance of removing either phosphorus or nitrogen was observed.

Dr. P. H. Jones was one of the most active voices in the move to restrict the amount of phosphorus in laundry detergents. His outspoken views were published in Water & Pollution Control magazine in a September 1968 interview. Many feel this article was an important factor in the subsequent Federal legislation which restricted phosphorus in Canadian detergents.

As a good part of the phosphorus enrichment of Great Lakes waters was provided by the effluent of sewage treatment plants, a province-wide phosphorus and other nutrient control program was established in 1971. The program set 1973 and 1975 as deadlines for phosphorus removal facilities at 210 municipal sewage treatment plants.

On April 1, 1972, the OWRC was integrated into the new Ministry of the Environment which continued with the work initiated by the Ontario Water Resources Commission.

Under the Canada-Ontario Agreement, the Ministry of the Environment was responsible for the phosphorus removal program. In 1976-77, the provision for phosphorus removal at all significant municipal discharges was completed. In November, 1978, a U.S.-Canada agreement set new Great Lakes water quality objectives. They involved tighter controls on the discharge of toxic substances, new phosphorus loading targets and dates for the completion of municipal and industrial pollution abatement programs, and objectives regarding radioactivity.

By 1980, 220 Ontario wastewater treatment plants with phosphorus removal facilities removed 7,000 tonnes of phosphorus yearly from sewage plant effluents.

By 1982, there were 360 publicly-owned wastewater treatment plants in operation in the province, most of them with secondary treatment and many of them also providing phosphorus removal. Together, they handle over 1 billion gallons of sewage daily.

During 1982, of the total 360 facilities, the province operated 213, mostly in smaller municipalities that were unable to afford the full cost of treatment. Municipalities operated the other 147 facilities, handling 74 percent of the total wastewater treatment capacity in the province. Communal waste treatment systems now serve 94 percent of Ontario's urban population or 82 percent of the total population.

The chemical industry has, in the past thirty years, developed at a very fast pace, to the extent that the total chemicals and chemical compounds now number in the order of six million. The nature and danger of PCBs has become universally known and plastics of all types have been developed.

In the 1970's, mirex and dioxin became familiar names and each was recognized as significantly dangerous if present in a raw water supply. Similarly, nuclear wastes received great emphasis in the 1970's and their dangerous characteristics are such, that disposal on, or in the earth remains a problem today, let alone allowing any amount to discharge into our lakes or rivers.

From a technical viewpoint, all agencies are heavily committed today to understand and establish allowable limits for the myriad of chemicals and toxic substances that may be permitted in our raw water supplies, and in treated effluents to receiving waters or to the land. The Ontario Water Resources Commission and, subsequently, the Ontario Ministry of the Environment, have systematically placed more stringent regulations upon treatment plant operations and upon disposal systems, as the understanding of all such substances has progressed.

Sewage treatment design has been influenced in several ways. In recent years, the practice of land disposal of digested sludge has been substantially curtailed, wherever possibly dangerous substances have been recognized in the sludges. At the same time, the disposal of sludges by incineration has become more complex and costly because of air pollution control requirements. Suitable disposal for sludge solids is probably the most troublesome and contentious design problem in sewage treatment in the 1980's.

Compounding the problem of the increased numbers and complexity of substances to be treated, is the increasing size of communities,

compared to the assimilative capability of the receiving waters. The Kitchener-Waterloo-Guelph complex and the capability of the Grand River as a receiving stream is a case in point. For such situations, the Ontario Ministry of the Environment is requiring higher degrees of treatment, and tertiary treatment is evident today in several Ontario inland communities.

The designs for sewage treatment and the methods of operation have necessitated improvement in all areas over the past 35 years. It might be said, however, that the tools and the ideas have been sharpened, but very few actual breakthroughs have been made. A prime example is the activated sludge process, established in several plants throughout North America in the early 1920's. By its nature, it is an 85 to 90 percent removal process. Over the years, a great variety of improvements to both the structural facilities and to operational techniques have taken place, but, the net result of operating efficiency improvements is probably less than five percent overall.

At the same time, one major breakthrough in treatment is the heat treatment process for conditioning sewage sludge for dewatering. Pioneered early in this century in England, the process has been developed extensively in North America. The existence of various chemicals and other substances in modern day sludges produces sludges almost exclusively characteristic of a given community. Such dewatering devices as vacuum filters, centrifuges and presses thus must be tuned, if possible, to the sludge characteristic of a particular plant. To this end, several generations of polymers have been used over the years, and at considerable expense, in an attempt to condition sludges for satisfactory dewatering with the traditional equipment available. The heat treatment process appears to be a common denominator which transforms almost any given sludge into a state readily dewatered to autogenous moisture content by a variety of dewatering devices. In this context, heat treatment, or thermal conditioning of sewage sludges must be considered as a major breakthrough in the state-of-the-art. Indeed, with mechanical burning of sludges and heat recovery facilities, the sludge conditioning and disposal system can be energy self-sufficient, as demonstrated in at least three major plants in Ontario.

Economic reality, compatible with government regulations, respecting sludge disposal on land, has until recently limited complete mechanical sludge disposal to the very large centres. Indeed one rule of thumb has been that, if mechanical sludge dewatering can be justified, it is so only in concert with incineration, and, more recently, with heat recovery for energy. It is quite possible that more stringent regulations respecting final disposal of sludges may dictate mechanical sludge disposal in smaller communities as well.

As to other aspects of sewage treatment today, the following brief summary of practices may be recorded.

In the past several years the use of aerated tanks has been common in grit removal practice as the head loss is at a minimum in this type of tank. Grit is removed by air lift, screw pump or by clamshell bucket. The advantage of the latter method is its simplicity and there are no moving parts in the sewage flow. Grit removal through "controlled velocity flow" in shallow tanks has also been utilized in many plants.

A variety of screening equipment continues to be employed, although the older practice of macerating screenings immediately after, or as part of the removal procedure, has been substantially rejected. Travelling screens are employed in all but the smallest plants, with screenings dewatered and removed for burial on-site, or at a municipal waste site.

Primary settling tanks continue to be constructed of either rectangular or circular design. In either type, the mechanisms for scum removal have been adjusted and renovated over the years by both plant and equipment designers. For rectangular settling tanks, which require less space on site, manufacturers have striven to use plastics and other materials in order to lengthen the life of collection mechanisms. A number of sludge collection devices have been introduced. One of the successful alternatives is the travelling-bridge, lifting-blade type, used in some plants in Ontario since 1965. With this equipment, the travelling bridge and lifting blade can be isolated from the tank for inspection and repair, without dewatering the settling tank.

Sewage aeration has probably received more attention by manufacturers and plant designers than any other phase of treatment. Aeration tank shapes have been studied and tested as to optimal depth, width, wall characteristics, port locations and other features. Almost countless aeration devices have been proposed by manufacturers, roughly categorized as fine bubble and coarse bubble devices. Materials have included cast iron devices with coarse bubbles, porous media of natural and synthetic materials, nylon mesh materials, all in various shapes and sizes. Since approximately 1960, many designs shifted from fine bubble to coarse bubble devices, in part because the requirements for suitably cleaned air are less stringent with coarse bubble.

During this era in Ontario, the step aeration mode of tank design provided for improved tuning of the aeration process to the existing aeration tank size, and commensurate with the strength of settled sewage applied to the tank. Because of these circumstances the Ministry of the Environment allowed aeration tank design loadings to be increased from a traditional (approximately) 25 pounds of BOD/1000 cubic feet of aerator, to 40 pounds of BOD/1000 cubic feet. Indeed, some plants have been operated for several continuous days at loadings of 70 and 100 pounds. The Dunnville Sewage Treatment Plant was designed for loadings in the order of 88 pounds BOD/1000 cubic feet and has been in operation since 1968. In one engineer's experience, the higher loading rates were successfully achieved using coarse bubble aeration devices.

In the mid 1970's, the cost of energy increased dramatically because of the world oil situation, and a new conservation awareness was added to sewage treatment parameters. Fine bubble aeration has become more popular again.

In recent years, aeration tanks in some plants have been provided with covers or roofs in the interest of odour control. The coverings and the manner of used air discharge have been a significant step in making treatment plants better neighbours in both commercial and residential neighbourhoods.

In addition to the odour control characteristics of aeration tanks, closer attention is being given by designers to odour control throughout

all operations. In recent years, because of extensive urban expansions, it is now impossible in Ontario to locate a treatment plant at a distance from a community sufficient for long-term isolation. Indeed, an isolated site today becomes a very close neighbour within one generation, as residential and commercial areas increase. The onus is, therefore, upon all designers to successfully eliminate odours and all other undesirable elements of treatment plants. There are now several examples in Ontario of "good neighbour" plants and one must anticipate that this requirement will be the norm in the future.

Another important aeration innovation has been the pure oxygen process, which has been marketed extensively by two or three major companies in the past 15 years or so. Its desirable features include completely covered reactors, very low oxygen quantity requirement and, therefore, substantially smaller quantities of gas discharged to the atmosphere. Pure oxygen plants have a definite place in the 1984 state-of-the-art and are being employed today for both municipal and industrial wastes. Objective comparisons with the traditional aeration tanks and devices, for a specific application, are the order of the day and the initial claims of being a general panacea for sewage treatment have largely disappeared.

Another major aeration device, developed in the past 20 years or so, is the rotating biological contactor (RBC), whereby metal or plastic discs are rotated in the sewage flow, under appropriate coverings. These devices are akin to trickling filters in that an attached growth of biological mass is developed on the rotating discs. They have been employed to date in Ontario for many small installations as well as for nitrification as a tertiary phase at the Guelph Sewage Treatment Plant where a high quality effluent is required for discharge to a receiving water. Design was commenced in 1984 for Ontario's first large scale use of RBC's for secondary treatment at the Regional Municipality of Niagara's Niagara Falls Sewage Treatment Plant. Start-up is scheduled for mid 1985.

Mechanical aerators with individual drives have been extensively developed and employed in the past few decades, for use in concrete or steel tanks and in aerated lagoons. Some devices have draft tubes while others employ only a surface rotor or a surface rotor with an extended shaft with a smaller lower impeller. Some of the larger treatment facilities employing mechanical aeration include Duffin Creek, Hamilton, London Greenway and Welland Water Pollution Control Plants. Reliable cold weather operation has been demonstrated in Ontario. In open lagoons, both fixed and floating platforms are employed.

A recent innovative aeration device is the deep shaft, claimed as a biological process for the treatment of domestic wastewater and biodegradable industrial effluents. The process was announced by Imperial Chemical Industries in April 1975, in England. It was developed as a spin-off from research carried out by their Agricultural Division into the production of single cell protein by aerobic bacterial fermentation of methanol. The first application in North America began operation in Paris, Ontario, in July 1976.

Final settling tank design has progressed in the past several years, as designers better understood the nature of density currents in these tanks. The literature contains two major papers on density current studies, one in New York and one in Chicago, both studies having taken

place around 1945. Considerable attention has been given by designers to the size and number of entry ports to the tanks, the baffling arrangements, the location of the return sludge suctions, and the rate of sludge return. Additionally, some plants in Ontario have U-shaped final tanks of various geometries. These are usually employed in smaller plants in order to provide short circuiting of return sludge and long circuiting of final effluent. Final settling tanks continue to be constructed of rectangular or circular design with some also constructed of square design with "corner sweeps" on a circular drive mechanism. Activated sludge removal from conventional hoppers has continued as well as the use of "rapid sludge removal" and "travelling bridge type syphon collectors".

Recent digestion tank practices have included the improvement of devices for safety, and an improvement in the agitation or stirring of tank solids, which has resulted in higher overall digester loading rates. Operational periods, with as low as 10 to 12 days detention, may be compared with the older standard of 30 days detention. The use of the digester gas for plant heating and other energy requirements continues. In those plants where sludge is to be incinerated, the digestion practice is slowly being decreased and may well be eliminated. Indeed, the heat treatment or thermal conditioning process, described earlier, appears to be optimally operated when using raw sludge rather than digested sludge.

Sludge dewatering continued to receive a great deal of attention in 1984, as manufacturers of the various types of equipment strive to produce sewage sludges which will be acceptable for disposal in municipal waste sites. Centrifuges of varying speeds, stationary sludge presses and the newer travelling belt sludge presses are all cost-effective today for specific situations. Incineration of sludge is carried out in either multi-hearth or fluid-bed type furnaces, with the latter type perhaps gaining more popularity over the past 10 to 15 years.

It is probable that energy recovery by use of waste heat boilers is or will be incorporated in the designs of all sludge incineration plants. To be cost-effective, designers today must consider the viability of energy recovery as well as the conditioning, dewatering and incineration processes. Their objective must be to make the total sludge disposal system energy self-sufficient.

In these mid 1980's, several medium and large size treatment plants have a computer installation to provide operational information for management and to directly control the various processes in the plant. As a result, even the largest pumping installations are unattended by operators and, throughout the plant, all operational valves and other requisite devices are now power-operated in order to be compatible with computer directed operation. Although it may be very improbable that a basic operating staff will ever be eliminated, it is certain that, in the medium and larger sized plants, the tediousness of normal operations may be eliminated and efficiency improved by computer use. At the same time, a maintenance staff will always be necessary, for traditional maintenance as well as for the equipment which computerization made necessary.

Receiving waters for treated plant effluent are now receiving considerable attention for both biological and chemical aspects of plant

discharges. In Ontario lakes, the Ministry's guidelines for mixing zones require consideration for each and every outlet. Additionally, the assimilation capacities of such systems as the Grand River, the Thames River and the Kawartha Lakes are being studied for total basin capacity and the degrees of treatment necessary. Nutrient removal regulations are becoming more stringent in plant effluent. Also, the long-term effect of chlorination as a disinfectant remains under scrutiny by the Ministry of the Environment. Lead, mercury, mirex, the dioxins and other toxics are also constantly studied.

In all, sewage treatment in Ontario has progressed rapidly since the end of World War II. The requirements for adequate sewage treatment placed on all communities by the Province, through the former Ontario Water Resources Commission, and subsequently by its successor, the Ministry of the Environment, have placed an obligation on and, at the same time, given an opportunity to all designers to further the state-of-the-art.

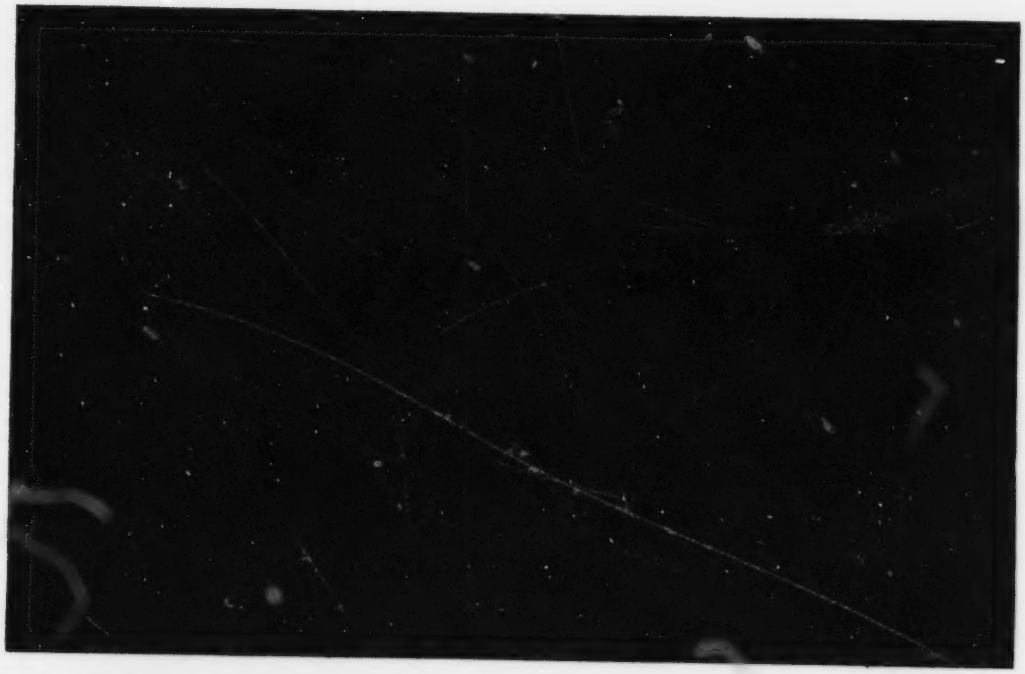
Ontario is in the forefront of governments throughout North America, with the quality of its receiving waters and the environmental quality of life provided for its people.

The communities of Ontario can be equally proud of their achievements in water pollution control. In this context, it must be recorded that normally about 85 percent of treatment construction costs are borne by the local community, with governments providing some 15 percent of construction costs. By comparison, in the United States the system provides for approximately 85% of the capital costs to be underwritten by the federal and state governments.

Treatment plant designers have responded with progressively more economical and efficient designs. Although complete innovations may be minor, there have been innumerable improvements to the state-of-the-art, since the days of Berlin's septic tanks and sand filters.

The people of Ontario and its design engineers are ready to enter the next decade, or even century, of progressive developments in order to safeguard the province's water, land and air.

Leaside "Sewage Disposal Plant" 1913 (close up of inlet channel, screening and settling tank).



York Township "Sewage Disposal Plant" 1928 General View: 5,000,000 gpd plant incorporating "storm tank, aeration, mechanical clarifiers and sludge dewatering by vacuum filter".

York Township "Sewage Disposal Plant" 1925 Clarifier Unit (note: square tanks with circular sludge collector with "corner sweep" in background).

Long Branch "Sewage Disposal Plant" 1924 "Aeration Channels".

York Township
"Sewage Disposal Plant"
1925

Sludge Pump

Aeration Channel

CHAPTER THREE

THE CONSULTANT'S ROLE

Canadian consulting engineers played a significant role in designing and installing state-of-the-art sewerage systems and treatment plants. In the early days, the versatile engineers of the 19th Century moved easily from designing canals to railways, to water works. Some names crop up repeatedly throughout this book. The Ontario born **Thomas Keefer**, whose 1859 Hamilton water pumping station can be seen today, in magnificent working condition, became Chief Engineer of the Montreal Water Works in 1853. He was employed, often in a consulting capacity, sometimes as an employee, on waterworks projects for such cities as Toronto, population 100,000, St. Catharines, Hamilton, Quebec City, Ottawa, London, Halifax and Dartmouth. In 1872, he became Chief Engineer of Ottawa Waterworks. Always aware of the need for engineering education, he was instrumental in introducing civil engineering studies at McGill and became its first professor of engineering in 1856. This remarkable Ontario engineer died in 1915 in his 94th year. While not a consultant as such, he provided consulting services, as well as laying the bedrock for education in civil engineering.

His half brother Samuel, born 1811, worked on many canal and railway projects. As a further example of his versatility, **Samuel Keefer** selected plans for the Parliament Buildings in Ottawa, directed construction of the Parliament complex and arranged the three buildings in the open quadrangle which exist today. While both brothers did much of their engineering as employees, it is believed that they sometimes acted as consultants, or employed consultants.

But another Ontario-born engineering giant, **Willis Chipman**, was emerging who almost certainly was Canada's first major environmental consulting engineer. Like the Keefers, he became a force in reshaping the engineering profession through his work on professional associations. He is referred to more fully in Chapter 1.

In 1901, he joined forces with a former assistant, Mr. George H. Power and began a consulting partnership under the name of **Chipman and Power.**

Chipman and Power, the first major environmental consulting firm in Canada, completed both waterworks and sewage treatment projects in some 50 cities and towns ranging from Halifax, Nova Scotia, to Victoria B.C., until the firm ceased operations in 1924 - on Willis Chipman's 69th birthday.

It is interesting to speculate why the firm - which dominated environmental engineering in its era - did not continue with younger engineers infusing fresh life into the firm. Other consulting engineering firms continually regenerated themselves when younger professionals entered their service. Chipman and Power, for reasons now obscure, thrived for over two decades then languished after making a most distinguished contribution to Canadian environmental engineering.

The honour of the oldest firm continuing today belongs to **J. T. Donald Consultants Limited**, Consulting Engineers and Chemists, of Toronto, which succeeded the original firm established in 1880 as analytical

chemists, and which continued to conduct chemical analysis and assay work until approximately 1935. Between 1935 and 1965, a division of the firm was incorporated to provide inspection and testing services of construction materials. Since 1965, consulting engineering services have been provided in geotechnical reports, construction materials and chemistry.

The firm of **C. J. Clarke and Associates** can trace its origin to 1884 and the practice of George Ross, Professional Engineer and Ontario Land Surveyor in Welland. The firm passed on to Mr. Russell Scott, P. Eng., OLS, in 1920. In 1951, C. J. Clarke, in partnership with Mr. Scott, opened offices in Port Colborne. The modern firm continues today under Mr. Clarke.

In 1892, **Mr. William Newman** began practising as a civil engineer in Windsor. In 1902, he was joined by his brother John, designated as a civil engineer and Ontario Land Surveyor. The brothers continued their practice principally in the Essex, Kent and Lambton county areas until 1906 when William became City Engineer of Windsor, leaving John to carry on the practice. This founding practice continues in the modern firm of **La Fontaine, Cowie, Buratto and Associates Limited.**

Mr. C. G. Russell Armstrong, who joined John Newman in 1923, noted from William Newman's old index book, that William's early engineering projects included the following:

1893 Sarnia Indian Reserve
1898 Petrolia Waterworks
1898 Prescott Sewers
1900 Perth Waterworks
1906 Michigan Central Railway Tunnel.

Mr. Russell Armstrong remained partially active in his land survey-drainage engineering firm in Windsor with his son, Maurice.

In 1906, Homer W. Sutcliffe founded a firm in New Liskeard, Ontario, which, after various reorganizations, continues today as **H. Sutcliffe Limited.** Its principal activities are municipal civil engineering and land surveying. This is the oldest continuing engineering firm in the northern area of Ontario.

In the year 1910, in Chatham, Ontario, **George A. McCubbin, OLS,** established a surveying practice. A communication from Todgham and Case Associates, Consulting Civil Engineers, notes that their firm and a second firm, **E. C. Brisco Limited,** both descended from the original practice of George A. McCubbin.

Born in Burford in 1869, George McCubbin began his career by teaching for six years in St. Thomas. In 1895, he was admitted to practice as an Ontario Land Surveyor and subsequently carried out a number of Township surveys in northern Ontario.

Joining James A. Bell in partnership in St. Thomas, Mr. McCubbin subsequently became involved in drainage engineering and travelled extensively throughout south-western Ontario in this field. Because of the flatness of Essex, Kent and Lambton counties, good drainage was essential for the development of their agricultural potential and Mr. McCubbin found a ready market for his services.

Herb Todgham, of **Todgham and Case Associates**, in his communication, notes of Mr. McCubbin as follows:

> "He would take the train from St. Thomas to Blenheim and then to Chatham where he would hire a horse and buggy to take him to the various project sites. Occasionally, he would stay overnight at a local farm house rather than travel all the way back to town.
>
> George McCubbin was the type of person that liked to see things fit. When he found that a new surveyor's dumpy level that he had just purchased could not be stowed neatly under the buggy seat because the case was too high, he had both the case and the level rebuilt, even though this involved the rather complicated procedure of moving the level's bubbletube from its normal position beneath the telescope, to a special mount on the side.
>
> Because of his years of personal experience both in drainage engineering and in the application of the Municipal Drainage Act, George McCubbin's services were in demand across the province and he spent a great deal of time as an expert witness in the many drainage law suits that took place in the 1920's and 1930's."

Herb Todgham and E. C. Brisco Jr., both of whom are Ontario Land Surveyors and Professional Engineers, were involved with Mr. McCubbin in the latter part of his 56 years of practice, until he died in 1951. Subsequently, Brisco and Todgham dissolved the partnership and Todgham joined with Bill Case to form the current continuing land survey and engineering company. A large part of the practice continues to be in the field of drainage engineering. For many years, Bill Case was a scrutineer at CIPC/PCAO elections and his role became a PCAO tradition.

In the Ottawa area, the oldest continuing firm is that of **McRostie, Genest and Middlemiss**, established in 1914, as a partnership under the name of Lewis and McRostie. The current president, Gordon C. McRostie, is a nephew of the firm's founder.

Exemplifying the land survey origins of the firm, in the 1920's Messrs. McCubbin, and McRostie, with a Mr. McGeorge, all OLS's and engineers, were acknowledged to be the province's premier experts on the Municipal Drainage Act, and their services were in high demand for the various types of suits which evolved from time to time.

The modern firm is involved principally in geotechnical engineering.

The year 1912 saw the beginnings of the **Proctor and Redfern Group**, the oldest continuing municipal consulting engineering firm in the Toronto area. The practice was founded by E. A. James who at the time was the engineer for York County (he continued in this role as well as being senior partner in the firm until his death in 1928). Mr. James came from an old established York County family and in his book on Practical Road Building, published in the early 1920's, he referred to the fact that he was the fourth generation in his family to have worked on the construction, reconstruction or maintenance of Yonge Street.

These were exciting times in municipal engineering. With the rapid increase in the number of automobiles, much attention and many dollars were being spent on the improvement of urban and interurban roadways and the time-honoured macadam and corduroy roads were giving way to a

variety of "modern" surfaced roads. As well, with the development of electrical distribution systems, it was possible for many smaller communities to embark on a number of sanitary engineering projects, involving community water and sanitary sewerage systems.

From the start, the firm provided consulting services to municipalities in roads and municipal engineering.

Prior to the First World War, Mr. James was joined by C.S.L. Hertzberg and T. R. Loudon, the firm becoming James, Loudon & Hertzberg, with substantial expansion of the practice in industrial engineering.

With continued expansion in the highways field, E. M. Proctor joined the firm in 1914 to head up the bridge design section, with the promise from Mr. James of at least six months' work. Mr. Proctor, a 1908 University of Toronto graduate, had worked for Chipman and Power and, immediately prior to joining the firm, was with the bridge design group of the City of Toronto.

The first sewage treatment plant the firm designed was for the Town of Leaside, being developed in 1914.

During the war Mr. Hertzberg went overseas with the Canadian Engineers and Mr. Loudon with the Royal Flying Corps, both being abroad until the cessation of hostilities. On their return it was found that there was not enough work for all of them in the heavier civil engineering area and Messrs. Hertzberg and Loudon left the practice to join with Mr. Harkness in the firm of Harkness, Loudon & Hertzberg, a firm specializing in civil and structural engineering. This firm was pre-eminent in the Toronto area during their years of practice in structural engineering, with such projects as the Sun Life Building in Montreal, Canada Life Building in Toronto, the original Bank of Commerce Building, the Park Plaza Hotel and many others. T. R. Loudon ended up as head of both the civil and aeronautical engineering departments of the University of Toronto. Mr. Hertzberg joined up again in 1939 and, shortly thereafter, became the senior serving engineer with the Canadian Army, reaching the rank of major general.

Upon return from overseas in June 1919, W. B. Redfern joined the firm. He was a 1908 University of Toronto graduate, a classmate of E. M. Proctor, and had had substantial municipal engineering experience before the war with Chipman and Power and, later, as Town engineer of Steelton, now part of Sault Ste. Marie, Ontario. The substantial and complementary talents of these two made their ultimate success inevitable, according to Roy Tredgett, a past Proctor & Redfern president.

In 1922, the firm was restructured and the name - The E. A. James Co. Ltd., since Messrs. Hertzberg and Loudon's withdrawal in 1919, was again changed to James, Proctor & Redfern Ltd., a name which carried on without change until 1944 when the Proctor & Redfern relationship was, and continues to be, emphasized.

In that same year, all three principals became charter members of the Association of Professional Engineers of Ontario. The firm subsequently had two of its partners serve as Presidents of the APEO.

The firm prospered during the 1920's, and was engaged in a great variety of municipal engineering work, including the original Scarborough Waterworks, York Township Activated Sludge Plant, Mimico-New Toronto Union Sewerage Commission, North York Waterworks System, Forest Hill Village municipal services, and many others, province-wide.

During the early depression years, the firm continued to prosper for, in those days, many day-labour projects were initiated with the firm not only being involved with design, but also construction supervision in a detailed sense. However, by the mid 1930's, most government funding was badly stretched for programs of this nature and work was scarce until the Second World War. During the war, efforts were largely devoted to such projects as service camp installations, with municipal work curtailed by these priorities. In the late 1940's, G.E.M. "Ted" Proctor and Donald Redfern, sons of E.M. and W.B., joined the firm and this unique two-generation tie provided continuity and stability for the firm for the next generation.

The post Second World War era saw tremendous growth and the establishment of a number of branch offices throughout Ontario and Atlantic Canada.

During this period, over one hundred sewage treatment plants were designed as well as a similar number of water supply projects. The firm has been active in the private land development area as well. Over a million people in the general Toronto area live in subdivisions, the sanitary engineering services for which were designed by Proctor & Redfern.

The firm has also been engaged on a number of major sanitary engineering projects abroad, including the Kathmandu Valley area and ten other cities in Nepal for the World Bank and a project in Ecuador.

Sid Dutton, an active PCAO member for many years, headed up the firm's waste treatment group for a quarter of a century and has been responsible for the design of some of Ontario's most significant projects. He is still active on a number of assignments. He is a past president of the PCAO and was given the Bedell Award for his contribution.

Don Redfern, the firm's chairman, has been a long time PCAO member and served on the Canadian Institute on Sewage and Sanitation Board and assisted in the foundation of the Federation of Associations on the Canadian Environment. Earlier in his career, he headed up Proctor & Redfern's sewage treatment group. He is a past president of the APEO and holder of the APEO Sons of Martha Medal.

Showing unique continuity, the current president, P. A. Hertzberg, is the son of one of the early partners. Peter, himself a military engineer, acted as project manager on the Duffin Creek treatment plant.

In recent years both Mr. James and Mr. E. M. Proctor have been elected to the Engineering Hall of Distinction of the University of Toronto, signifying the leadership they provided in their profession.

Gore & Storrie Limited, started some five years after Proctor & Redfern.

The original partnership agreement among Messrs. William Gore, Consulting Civil Engineer, Dr. George G. Nasmith, Bacteriologist and Public Health Specialist, and William Storrie, Consulting Civil Engineer, was dated October 1, 1919. The parties entered the partnership for a term of five years to carry on business as consulting civil engineers and public health specialists as Gore, Nasmith and Storrie.

Mr. Gore was a native of England and received his technical education at the City and Guilds Institution of London, England, of which he was a Fellow. He won the Norfolk County Scholarship in 1893, the Whitworth Exhibition in 1894, the Siemens Memorial Medal in 1896 and the George Stephenson Medal in 1907. By 1928, Mr. Gore was the only person who had won all of the latter three awards.

For many years he was an assistant on the staff of the late George Deacon, recognized during his later life as the foremost waterworks and hydraulic engineer in Great Britain. On the death of Mr. Deacon, Mr. Gore became general assistant to Sir Alexander Binnie, Consulting Engineer to the London County Council, and for a period of fifteen years was engaged on water supply problems in many of the leading cities in the world. In this period with Mr. Binnie, he was directly involved in design of the original Aswan dam in Egypt.

Before entering partnership with George Nasmith and William Storrie, his engagements included the following:

London County Council -- complete scheme for obtaining a water supply from Wales at a cost of $160,000,000.

Petrograd water supply at a cost of $7,000,000.

Merthyr-Tydfil water supply at a cost of $7,000,000.

Toronto water purification plant completed in 1918 at a cost of $1,200,000.

Dr. Nasmith was a native of Toronto. He had an M.A., Ph.D., D.P.H., and D.Sc., all from the University of Toronto, and was given the C.M.G. for distinguished services to the British Army in France in health and sanitation work in World War I.

He was advisor on health and in full charge of water supply for the First Canadian Contingent and later on was officer commanding No. 5 Mobile Laboratory in France which had full supervision of all water purification for the First Canadian Army and latterly the Second British Army in the field. Dr. Nasmith devised field methods for purifying water used by the armies in the field and was responsible for the mobile filter unit used by the armies.

Dr. Nasmith, then Lieutenant-Colonel, was at Ypres, France, in April, 1915, on the occasion of the first gas attack by the enemy. A full accounting of the particular attack, his recognition of the gas as a combination of chlorine and bromine, his actions in the field and a full technical and practical discussion of gas warfare is recorded in the July 26, 1919, edition of the Medical Record.

From 1902 to 1909, he was chemist and bacteriologist to the Provincial Board of Health for Ontario and, from then until 1919, he was Director of Laboratories for the City of Toronto.

In 1903, he operated an experimental sewage treatment plant at Kitchener, and from 1916 to 1921, was in charge of a similar experimental plant for the City of Toronto.

In conjunction with Mr. Gore, he supervised an experimental water filtration plant for the City of Toronto. All chemical and bacteriological work connected with the operation of the 36 MGPD slow sand filter plant and 60 MGPD rapid sand filter plant for the City of Toronto was carried out for many years under his supervision.

Mr. Storrie was a native of Scotland and received his technical education at the Glasgow and West of Scotland Technical College. By examination he was an associate member of the Institution of Civil Engineers of Great Britain.

For seven years he was in the City Engineer's office of Paisley, Scotland, during which time he was resident engineer on the construction of extensions to the waterworks system, costing upwards of $3,000,000.

He came to Canada in 1909 and for three years was resident engineer on the construction of the first water purification plant for the City of Toronto, costing $800,000. During portions of 1912 and 1913, he acted as waterworks engineer to the City of Ottawa. From 1914 to 1917, he was chief engineer on the design and construction of the second water purification plant for the City of Toronto, in conjunction with Mr. Gore.

During 1918 and part of 1919, he was in full charge of reinforced concrete construction work being carried out by the British Admiralty on the English Channel.

During the firm's early years, waterworks assignments were undertaken with the municipalities of Toronto, Port Credit, Ottawa, Belleville, Calgary and the Essex Border Utilities Commission of the City of Windsor. By the late 1920's, sewage works assignments were initiated in Toronto and Orillia.

Throughout the 1930's, waterworks assignments continued, and extensive considerations were undertaken with the City of Toronto for establishing a main sewage treatment plant. These activities are detailed elsewhere in the book. The firm's original sewage treatment assignment in Toronto had been for the North Toronto plant. During this era, the firm was assisted, by agreement, by Metcalf and Eddy of Boston, a relationship which has continued, through friendship and mutual understanding, with or without formal agreements for many years.

The firm carried the three names in the title through two partnership changes occasioned by the death of Mr. Gore in 1934, and the addition of new partners. The name became Gore & Storrie on July 1, 1937 on the retirement of Dr. Nasmith, with the three continuing partners being William Storrie, Norman G. McDonald and James F. MacLaren. The 1937 agreement, as did the original, included the purpose "to carry on business as consulting engineers and public health specialists."

Mr. MacLaren left the partnership in 1950 to launch his own company which enjoyed spectacular growth, playing a major role in Canadian environmental engineering. His son, James W. MacLaren, also became a prominent figure on the environmental scene. The MacLaren Company is more fully described later in this Chapter.

Recognition of Mr. Storrie's stature as an engineer was publicly accorded on his attendance on April 2, 1953, at the provincial legislature, on the occasion of the passing of Bill 80 which established The Municipality of Metropolitan Toronto. For his assistance in preparation of the Bill, Mr. Storrie was presented with a leather-bound copy signed by the, then, Premier Leslie M. Frost.

Gore & Storrie was incorporated in 1954, with Mr. Storrie as President; then, following his death in May, 1955, Norman G. McDonald became President and so continued until 1964. A 1918 civil engineering graduate of the University of Toronto, Mr. McDonald had joined the firm permanently in 1922 after having, for the previous year, been city engineer of Oshawa, Ontario.

John Wilkie Argo joined Gore & Storrie upon graduation from the University of Toronto in 1929, as a civil engineer and became president of the firm upon Mr. McDonald's retirement. He gave substantial time to water and sewage oriented associations, and was presented with the WPCF's Bedell Award and the AWWA's Fuller Award for his services. Mr. Argo was the first president of the PCAO, and a founding Director of the Federation of Associations on the Canadian Environment.

John Giles Powell joined the firm in 1932 upon graduation from the University of Toronto in civil engineering. His experience included development of water supply and sewerage programs in a large number of communities principally in Ontario. He succeeded John Argo as president from 1970 to 1975, then continued as Chairman of the Board for two years. During Mr. Powell's years as president, the firm's staff increased substantially in size.

George B. Crawford, a University of Toronto (1944) civil engineering graduate, joined the firm in October, 1945, and became president in 1975. He became President of the PCAO and a member of the WPCF Board in Washington and he, too, received the Bedell Award.

Ronald A. G. Simmons succeeded Mr. Crawford in 1981, with Robert A. Goodings succeeding him in 1984. Both Mr. Simmons and Mr. Goodings were long time PCAO members, but their main focus was in the potable water disciplines. Both received the AWWA's Fuller Award for their services. Mr. Goodings also had served as an Ontario Section, AWWA Chairman and as President of the Federation of Associations on the Canadian Environment. Mr. Simmons became President of the Consulting Engineers of Ontario in 1984.

James F. MacLaren Associates was founded in 1950 by the late Dr. James MacLaren who had spent almost 40 years in the practice of sanitary engineering.

The initial staff, consisting of the founder, his son James W. MacLaren, W. O. Chisholm and the late D. G. Maclean, were active in a variety of projects for clients, including the Brantford Public Utilities Commission, the Town of Leaside, the Grimsby Water Commission, Pembroke,

Sarnia, and Fredericton and Moncton, N.B.

Impetus for future growth was provided in 1954 and 1955 with the firm's appointment, by the, then, newly-formed Municipality of Metropolitan Toronto, as prime consultant for the Humber Sewage Treatment Plant, a major water reservoir and several satellite water pumping stations. The balance of the 1950's was marked by expansion in the firm's traditional municipal engineering practice, involving the engineering of waterworks, wastewater and drainage works for a growing list of clients. These included the Department of National Defence, Ontario Hydro, Saint John, Newcastle and Woodstock in New Brunswick, Ottawa, London, Woodstock and Burlington in Ontario, and Regina, Saskatchewan.

The incorporation of the firm as James F. MacLaren Limited, in October, 1962, was followed shortly by the death of the founder who was succeeded as its chairman and president by James W. MacLaren. The decade of the 60's was characterized by continuing expansion and the establishment of subsidiary firms (MacLaren Atlantic Limited, MacLaren International Limited), affiliations (W. J. Cosgrove Associes, of Montreal) and branch operations in London, Windsor, Moncton, Halifax, Montreal and overseas.

The Ontario Water Resources Commission awarded MacLaren the engineering contracts for the Commission's first two regional water supply projects, the Lake Huron to London project and the Lake Erie project, serving St. Thomas and the Talbotville area. The first solid-waste master plan for Metropolitan Toronto was undertaken by the firm. Other major assignments included waterworks, wastewater, flood control and drainage works for new clients including the Metropolitan Corporation of Greater Winnipeg, the Towns of Burlington and Strathroy, the Cities of Owen Sound, Hamilton, Halifax and Toronto, the Greater Vancouver Sewerage and Drainage District, the Atlantic Development Board and many Ontario conservation authorities.

The firm's first significant international projects involving water resource development, water supply, wastewater control and drainage were undertaken in Libya, Nigeria, Haiti, Jamaica and Cyprus. Increased concern for pollution control on the part of industry introduced the services of MacLaren to new clients on major projects for the petroleum, chemical, steel, food processing, metal fabricating and electrical manufacturing sectors. It was also during this period that the firm's recognition of the increasing complexity of pollution control problems prompted it to establish its environmental laboratories, a hydrologic sciences division, the water treatment and waste disposal division and an air environment division.

With the advent of the 70's, new emphasis was given by the public and regulatory authorities to more rigid environmental controls and to increased attention to the potential adverse impacts of new developments. This led to MacLaren further extending its services to include regional, urban and environmental planning, ecological sciences, earth sciences, ocean sciences and radioactive waste management. The multi-disciplinary resources of the firm were backed by an in-house computer and expanded technical library services. Together, these resources enabled it to undertake, not only traditional pollution control and water supply projects, but also major impact assessments associated with large resource projects. These included mining, nuclear power generation and transmission, and petroleum and natural gas activities. Important projects in the firm's traditional fields

included coordination of the York-Durham regional sewerage program for the Ontario Ministry of the Environment, the design of the Easterly Water Purification Plant for Metropolitan Toronto, and major extensions to wastewater treatment plants in London and Winnipeg.

It was during this period that the firm's international involvement peaked with major projects being undertaken in Jamaica, Saudi Arabia, Egypt and in Nigeria where offices of MacLaren International Limited were established in both Ibadan and Jos.

The expansion of the firm's domestic operations also dictated the opening of branches in Fredericton, Winnipeg, Edmonton and Saskatoon. A new subsidiary, MacLaren Marex Inc., established offices and laboratories in St. John's, Newfoundland, and Dartmouth, Nova Scotia, to carry out offshore environmental and ocean studies for east coast and arctic petroleum and gas exploration.

In September of 1980, MacLaren became an autonomous division of the **Lavalin Group**, one of the largest wholly Canadian owned consulting firms in Canada. It was reincorporated as MacLaren Engineers Inc. with J. W. MacLaren continuing as Chairman and Chief Executive Officer until his decision to take a consulting role in 1982. The present company, under its president, R. D. Gillespie, continues its domestic and overseas practice of some 35 years as a principal environmental engineering arm of Lavalin, with primary emphasis on the conception, design and management of pollution control facilities and programs.

The environmental planning and research activities of MacLaren are now the responsibility of a sister division, **MacLaren Plansearch Inc.**, which was incorporated in 1981, with J. V. Morris as its president. The two divisions work closely together to form interdisciplinary teams on major projects requiring both environmental planning and engineering input.

Both of the MacLaren divisions benefit from the support of the Lavalin Group, comprising close to 6,000 employees in over 50 companies.

James W. MacLaren is a Fellow of the Engineering Institute of Canada, a Fellow of the American Society of Civil Engineers and one of three members of the Inquiry for the Canadian Government on Federal Water Policy, 1984-1985.

Roderick V. Anderson recalls that the depression years of the 30's and World War II, from 1939 to 1945, imposed severe restrictions on the design and construction of public works. Financing, materials, equipment, technical personnel and skilled labour were either unavailable, or in very short supply.

The restrictions did not apply to projects connected with the war effort, and construction activity took place in all provinces with amazing speed on plants required for supplying explosives, shells, aircraft and war equipment, and on sites used for radar warning stations, or on training centres for the army and air forces.

Costs were not allowed to interfere with the emergency, and, when some figures were challenged in the House of Commons in Ottawa, it led to the famous reply by C. D. Howe, the cabinet minister who directed Canada's war construction effort: "What's another million?" he asked.

Two essential items in all army and air force training centres were water supply systems for both drinking and fire protection, and sanitary sewerage systems and treatment plants that would give the highest degree of treatment that the state-of-the-art of that era would permit.

This created a demand for consulting engineering services that was further intensified when a crisis developed in the early fifties between North and South Korea, and Canada's Armed Forces were re-activated to prepare for a possible emergency. The backlog generated in municipal projects from both the depression and the war efforts resulted in a boom in the 50's and 60's for consulting engineers.

Graduating from the University of British Columbia in 1931, Rod Anderson spent most of his career in Ontario as a consulting engineer. He started with two design-draftsmen and a part time secretary in 1946, but quickly expanded with an infusion of graduate engineers.

He was retained for the design of sewage treatment plants, by a number of Ontario towns, all of which later retained the larger and well established firm of **R. V. Anderson Associates Limited** for expansions to their present-day capacity. The firm has engineered over 100 plants, extensions and pumping stations, ranging in size from a few hundred cubic metres per day to several hundred thousand cubic metres per day, with completed projects in Ingersoll, Welland, Thunder Bay, Metropolitan Toronto, Southampton, Elora, Milton, Acton, Ailsa Craig, Tillsonburg, Dunnville, Huntsville, Marmora, Minden, Dresden, Hanover, Walkerton and many other Ontario cities and towns. Tertiary filtration, nitrification and dechlorination facilities have been designed in order to meet stringent effluent discharge requirements.

In contrast to Chipman and Power's single ownership control, the Anderson firm was based on associate status, with share ownership following a 1951 incorporation. This provided needed continuity and stability, so that when Mr. Anderson retired in 1974, Kenneth A. Hyde, a graduate of the University of Manitoba, took over as president and has capably fulfilled that office for the past 11 years, with Dean Richard serving as Chairman until his retirement in 1984.

Mr. Anderson served as a director and President in 1966-67 of the Association of Consulting Engineers of Canada. He was also, in 1957-58, President of the Canadian Institute on Sewage and Sanitation. In 1970, he was presented with the James F. MacLaren Award for Pollution Control Achievement by the Canadian Institute on Pollution Control.

M. M. Dillon Limited, Consulting Engineers and Planners, began in 1945 as a gleam in the eye of Brigadier M. Murray Dillon, then Deputy Quartermaster General of the Canadian Army in Ottawa. The war of 1939-45 was over and most of the commissioned officers who were serving in the Corps of Royal Canadian Engineers were anxious to be discharged and return to civilian employment. Among other tasks, Murray Dillon was required to review each engineer's request for release.

Before the War, Murray Dillon had been a sometime salesman of building products and an independent structural engineer, and he realized that his own future career should probably follow in somewhat the same path. He could foresee a major post-war construction program, with a need for many more consulting engineers in Canada than then existed. Wisely, he

felt that he needed a partner to establish a business and, from the files of many crossing his desk, he selected George E. Humphries as a likely candidate.

George, somewhat older than the average army engineer, had had considerable pre-war experience as a prospector, surveyor, and mining engineer. A partnership deal was made and together they both left the Army to open their office in London, Ontario.

With Murray Dillon's marketing skills and George Humphries' considerable engineering talent, their early years were reasonably successful. The practice was in southwestern Ontario and the bulk of the projects were confined to the design of industrial buildings, steam and refrigeration plants, and bridges. Additional engineers, mostly ex-service men, were engaged and, for a short while, an architect was a full partner. By 1950, the staff had grown to approximately 20.

The year 1951 was a significant one. W. Kennerley (Ken) Clawson, then Engineer of Middlesex County and formerly with Horton Steel, was persuaded to join the firm and thus the first major step was taken to broaden the practice by moving into the water supply and sewerage fields.

By 1953, it became evident that a partnership was not the best way to operate a growing company and it was incorporated as M. M. Dillion and Company Limited (in 1964, this was changed to M. M. Dillon Limited). The first of many steps was taken to broaden the geographical scope of operations and the first branch was opened in Toronto.

Over the next twenty-five years offices were opened in Windsor, Winnipeg, Sudbury, Ottawa, Cambridge, Yellowknife, Thunder Bay, Edmonton, and Miami, Florida. At one time the staff exceeded 400.

Transportation Planning Associates, a U.K. specialist firm in which Dillon was an initial partner, was fully acquired and operated for over 15 years before being sold in 1983.

In its 40 year history, there have been four presidents: Murray Dillon, George Humphries, Ken Clawson, and, since 1980, Jim Kearney.

With a multi-disciplinary staff, the firm's practice can best be broadly described as "planning and design consultants for transportation, environmental engineering, and urban development projects." In addition to work in Canada, assignments have been completed in the United States, the United Kingdom, Eire, the Middle East, the Caribbean, and in Southeast Asia.

The 1984 merger with H. J. Porter and Associates of Halifax has now extended the operation to the Atlantic Maritime Provinces -- and is known there as Porter Dillon. Company offices are currently maintained in Alberta, Saskatchewan, Manitoba, and Ontario (5).

Professor O. J. (Oscar) Marshall and Professor H. L. (Harold) Macklin established the partnership of **Marshall and Macklin** on August 5, 1951 after working together on a number of summer projects between 1948 and 1951. On March 1, 1952, P. A. (Pat) Monaghan joined the firm as a

partner and the name was changed to Marshall Macklin and Monaghan. In 1957, the partnership was incorporated as Marshall Macklin Monaghan Limited.

Marshall Macklin and Monaghan, undertook responsibility for surveys for the Montreal to Toronto and Ottawa Trans-Northern oil pipe lines and quickly staffed up to more than fifty people. J. W. L. (Larry) Monaghan was among the first employees. The survey for Trans-Northern Pipelines was the firm's first major assignment which was quickly followed by surveying and engineering work for Don Mills Developments for early development phases of Don Mills, and for the Ministry of Planning and Development and the Board of Trustees for the Town of Elliot Lake. These three major projects for clients, who are still clients of the firm, established Marshall Macklin Monaghan Limited as a major consulting engineering, planning and surveying firm in Ontario.

The firm's first sewage treatment plants were two plants for Elliot Lake in 1956-1958 and a plant for the Bay Ridges Development in Pickering in 1960. Ontario Hydro's New Town #2 (Long Sault) on the St. Lawrence Seaway was a major job for which the firm provided the design of all municipal services including water supply and distribution and sewage collection and treatment systems.

The Elliot Lake project involved the planning, design and contract administration for the development of the entire community of 25,000 people, including the water and sewerage systems. Similar services were provided for the Bay Ridges Development to service approximately 10,000 people.

In 1961, Marshall Macklin Monaghan Limited expanded its consulting practice to the international sphere when it became a member firm of Cansult Limited. The firm planned, designed and supervised the construction of major sewerage systems including treatment plants in Kingston, Jamaica through CIDA, and in the Saudi Arabia capital city of Riyadh and the holy city of Medinah.

Commencing in 1968 for the OWRC and subsequently for the MOE, the firm has planned and designed water and sewerage systems for a number of Ontario communities, including Hespeler, Burks Falls, Sudbury Region, Thamesville, Sundridge, Manitowaning and Moosonee. The company was a consultant for the MOE on both the South Peel and York Durham Sewerage Schemes.

Marshall Macklin Monaghan has planned and designed water and/or sewerage systems in a number of municipalities in Ontario, including Richmond Hill, Vaughan, Matachewan, York Region, Essex County, Big Trout Lake, Cambridge, Newmarket, Markham, Kitchener, Halton Region, Durham Region, Belleville, Muskoka District and Moose Factory Island.

Recent large assignments in the water pollution control field include the design and contract administration of a large industrial waste treatment plant for Polysar in Sarnia, a major expansion to the Riyadh sewage treatment plant in Saudi Arabia, new sewage and water treatment plants for Elliot Lake, a major sewerage project for Amman, Jordan, three sewage treatment plants to service medium-sized cities in Saudi Arabia and a major design and contract administration assignment through CIDA to service the city of Belize with water, sewerage and solid waste facilities.

In Ontario the

O W R C

Ontario Water Resources Commission

is ready to serve you through your community

Since April, 1957, the OWRC has been helping Ontario cities, towns, villages and townships solve water supply and sewage problems. Since then the Commission has entered into agreements with 32 municipalities to build works for those places.

Water Supply	Sewage
Port Perry (in operation)	Stratford (in operation)
Sunderland (in operation)	†North Bay
Havelock (in operation)	†Widdifield Tp.
Alfred	†West Ferris Tp
Winchester	Trenton
Dundas	Tillsonburg
Markham Township	Brampton
Essex	Brantford
Bancroft	Toronto Tp.
Dresden	Bancroft
Frankford	Port Arthur
Harrow	Coniston
Richmond Hill	Frankford
*Essex	Richmond Hill
*Gosfield North Tp.	Korah Tp.
*Gosfield South Tp.	Streetsville
*Maidstone	
*Leamington	
*Mersea	

*Essex County integrated water supply pipeline project
†Integrated sewerage project

The estimated cost of these works is approximately $20,000,000

The Commission is at your service for construction of projects for assistance in water supply, sewage and industrial waste problems, laboratory examinations of all kinds and in stream pollution abatement.

Ontario Water Resources Commission

East Block, Parliament Bldgs., Toronto

A. M. SNIDER
Chairman

DR. A. E. BERRY
General Manager

Major sewerage assignments were also undertaken in Africa for the City of Kano in Nigeria, for Dar Es Salaam and Arusha in Tanzania.

In 1979, the firm expanded its operations to Western Canada, opening offices in Calgary and Edmonton. Several smaller, but interesting water pollution control and solid waste management projects have been undertaken from those offices, including sewerage systems for Miette Hot Spring in Jasper National Park, for Fortress Mountain Ski Resort in Kananaskis County, for the Agricultural Canada Animal Research Centre in Lethbridge and for several native communities throughout Alberta and Saskatchewan.

Marshall Macklin Monaghan also has carried out several significant solid waste management assignments, the most significant of which was the planning, environmental assessment and preliminary design for the very large Maple Pits landfill project for Waste Management Inc. Several solid waste management projects have been completed by the firm for the following clients; Bruce County, Drayton Valley, Evansburg/Entwistle, Superior Sand and Gravel/CN Rail, the Atkinson Foundation and the Department of Indian Affairs and Northern Development.

In the water quality field, the company completed, in 1977, an extensive study of Non-Point Source Pollution Remedial Measures for the Great Lakes Basin for the IJC and, more recently, the Elbow River Watershed Management Plan for the City of Calgary to determine what measures are required to protect the cities' major source of water supply.

Totten Sims Hubicki Associates was founded in 1962 with the objective of providing general engineering services to municipal and other clients. Projects have been, and are carried out throughout Ontario.

In 1966, a sanitary engineering department was established under the direction of Peter Eberlee. It was during this period that provincial commitment to the provision of water pollution control facilities for even the smallest urban communities began to develop, in a large part, as a result of intergovernmental agreements on Great Lakes water quality. Many of the company's established municipal clients became beneficiaries of provincial ownership funding for sewage collection and treatment. Totten Sims Hubicki began a decade of intensive activity in the design and supervision of construction of municipal sewage works.

This same decade also witnessed a very rapid increase in inflation in Canada and the costs of sewage works installations spiralled to the point where such demands on the Federal and Provincial treasuries could not be sustained. Inevitably, major policy changes were ushered in which have impacted on consulting engineering activities ever since.

The period of the late 1960's and early 1970's also witnessed tremendous optimism about the growth potential of Ontario's communities. Many studies were commissioned to plan for the expected increases in population, among them, for example, the Oshawa Area Planning and Development Study, (1969 to 1971). Totten Sims Hubicki participated in this large multi-disciplinary exercise, by providing the sanitary sewerage component for a study area, encompassing all of the, then, Ontario County, the City of Oshawa and part of the United Counties of Northumberland and Durham.

Early euphoria about growth prospects in this and other instances faded into a more realistic perspective. Nevertheless, the boom was realized in part and to a large extent within the limits of the Golden Horseshoe of Ontario. Such projects as the South Peel system, the York-Durham system and the individual regional municipalities' sewerage plans provided on-going work for consulting engineering firms. Totten Sims Hubicki participated in several elements of the York-Durham system including the earliest components, those in the south-west Pickering area.

In 1969, the firm was appointed by the Town of Whitby to develop a new sewerage system, known as the Corbett Creek sewerage system. This completely new system, jointly funded by the Town of Whitby and the City of Oshawa, provided a framework for the eventual growth of Whitby's population from 23,000 persons to its present level of 40,000, and for similar growth patterns in Oshawa.

Initially, the Corbett Creek system employed what was then a relatively untried concept in sewage treatment. The "completely mixed" activated sludge process was provided at relatively low cost, allowing the Town of Whitby to make an affordable entry into a completely new sewage treatment system, not an easy task for a municipality of its size. System modifications became necessary after the passage of time and now the treatment plant has a design capacity of 8 million gallons per day. Major additions have been carried out over the years by the company on behalf of the Region of Durham.

Initial planning for the Corbett Creek system anticipated rising energy costs as an element in total operating costs and, with careful planning, all sewage in the system flows to the treatment units by gravity, without pumping. Later diversions of drainage areas outside the system boundaries have required the establishment of a limited number of pumping stations.

During the 1970's and 80's, a number of other new sewage collection and treatment systems were planned and built under the company's supervision, including those at Cobourg and Bowmanville.

Operating under the management of R. B. Baker, the company's environmental group has directed considerable attention in recent years to improving the performance of existing sewer systems, thereby reducing the load on treatment plants and the by-passing of partially treated sewage.

Inflow/infiltration study methodology has been refined and applied to a number of clients' systems with positive cost/benefit results.

In 1983, Totten Sims Hubicki acquired powerful Computer Assisted Design and Drafting Equipment. Shortly afterwards, the company began the production of drawings for sewage pumping stations and other installations on the CADD equipment.

Ainley and Associates Limited, Consulting Engineers and Planners, was established as a consulting practice by P. Wm. Ainley in 1961 and incorporated by Ontario Charter, in 1967, as Ainley and Associates Limited. Offices are in the Town of Collingwood and the Cities of Barrie and Belleville.

For 20 years, the company has designed and supervised the construction of many wastewater collection and treatment facilities. The President of the firm, William Ainley, has served as a Director and President of the Consulting Engineers of Ontario.

In the early 1960's, sewage treatment lagoons were in vogue and the firm designed and supervised the construction of many such facilities. Two of the most interesting were the Township of St. Edmunds (Tobermory) lagoon and the Town of Thornbury lagoon.

The Tobermory lagoon was constructed in 1974 to service a population of 3,400 and to receive and treat the sewage from the ferry Chi-Chee-Maun which docks at Tobermory three times per day and discharges 10,000 gallons of sewage each 24 hour period. The lagoon system contains an aerobic treatment cell which is lined with plastic, and the treated effluent from this cell is discharged into a disposal cell which is provided with an underdrainage system.

The Town of Thornbury sewage treatment lagoon system is on a larger scale, consisting of a 4.5 acre aerated cell equipped with four 20 HP surface aerators and two 10 acre polishing cells.

This unit was designed to treat domestic sewage from a Thornbury population of 2,400 together with the sewage from Georgian Bay Fruit Growers Limited, which is the town's main industry.

The industry processes fruit for three months in the fall after harvesting and has a highly fluctuating discharge, with the BOD characteristics of the sewage it produces being 10 times that of domestic sewage. The oxidation pond process is ideally suited to these particular shock load circumstances as it provides storage and extended treatment.

In 1979, the Town of Collingwood decided it would upgrade its somewhat outdated primary sewage treatment plant and retained the company to design a secondary treatment extension. In 1981, this $6.0 million expansion was constructed, improving BOD reduction of the effluent from 45% to 95%.

The Wasaga Beach Sewerage System was constructed between 1979 and 1982 to serve a recreational community, the "Longest Freshwater Sandbeach in the World", of 35,000 persons.

Because of the recreational nature of the area, a unique concept for disposing of the treated sewage effluent was developed. The sewage treatment plant was located high in the sand dunes, 60 feet above the Nottawasaga River. After passing through the standard secondary treatment process, the effluent is discharged into 'clear water' cells and soaks away through the sand. Nature's tertiary treatment process!

In 1983, a sewerage and water distribution system was started at a cost of $17.0 million to service the Four Season Recreational Area located in the Township of Collingwood on the south side of Georgian Bay between the Towns of Collingwood and Thornbury.

A vital part of this system is the tertiary sewage treatment plant and an unusual part of this plant is the very long outfall sewer. This 500 mm outfall stretches more than 3 kilometres into the bay. It is one of

the longest in Canada and was designed to ensure complete dispersion of the treated effluent far from the shore.

The $26 million Innisfil Sewerage Project commenced in 1983 to service the densely populated south-east segment of the Township of Innisfil between Barrie and Gilford. A 525 mm to 900 mm trunk interceptor sewer runs along the shoreline of Lake Simcoe and feeds a 'state-of-the-art' tertiary sewage treatment plant which discharges treated effluent into Lake Simcoe through a 600 metre long outfall pipe.

Another challenge was the Orillia Sewage Treatment Plant phosphorus removal project. The City of Orillia is located on Lake Simcoe and, over the past decade, the Province has made concentrated efforts to reduce phosphorus emissions into this ecologically-sensitive lake.

In 1980, Ainley and Associates was retained by the City to make pilot plant studies of tertiary effluent filtration aimed at reducing total phosphorus to 0.3 mg/L. During the study, the firm experimented with various alum addition locations throughout the plant and discovered that total phosphorus could be reduced to the required 0.3 mg/L with dual alum addition only. As a consequence of this, the anticipated tertiary effluent treatment facility was not required and a savings of over $2.0 million ensued to the City of Orillia.

Consulting engineers often reveal talents in other fields. Ben Davis is a consulting engineer who for years used his scuba diving experiences to extend the range of his professional services. Now with **Giffels Associates Limited**, he can list an impressive number of underwater qualifications, including the Past Presidency of the Underwater Club of Canada and Director of the National Association of Underwater Instructors.

Ben Davis is one of the few people who has profitably combined a sporting hobby into a useful extension of his professional services. While certain jobs offer a chance to relax comfortably in the aquatic environment, much of his underwater inspection work was performed amid the unspeakably dark horrors of blocked sewer pipes, a dangerous occupation.

Ben recalled a project in the 1960's, in a 1969 cover feature in Water & Pollution Control magazine. He and his partner Stan McClellan were assigned to inspect storm water outfalls in downtown Toronto near the lakeshore. When the manholes were lifted, workmen had to break through crusts of evil smelling sludge before the divers could lower themselves in. Constant-volume equipment, giving a surface air supply, was used to keep the divers from actual contact with the foul smelling water. "It was so dark", said Ben, "lights were completely useless. After being lowered in, we inspected the sewer line for 200 ft. on either side of the manholes. The sewers were supposed to be approximately 10 ft. x 8 ft., yet in some places we could hardly squeeze through. Spars had obstructed the flows causing silt and debris to accumulate. Over the years, the flow had gradually become more restricted."

Although these were storm sewers, the divers found an assortment of oil, grease, oatmeal and decaying food from packing plants in the sewers. When the divers emerged after one inspection, Stan took in a deep breath in relief after his mask was removed. A mistake. The hideous stench made him retch convulsively.

Other hazards to divers are the sluice gates in dams. Although the sluices were closed on one dam inspection, a small crack in the gate could have proved extremely dangerous. Ben Davis calculated that the leak at that particular depth would exert a holding force of over 700 lbs. More than enough to keep the diver on the job--permanently!

But not all jobs are unpleasant or hazardous. Underwater divers are particularly suitable as observers when new concrete intake cribs are being located on raw water intakes, or when sewer outfalls are being installed on the beds of rivers or lakes.

Although many consulting engineers now combine their engineering expertise with scuba diving, Ben Davis was certainly one of the pioneers in the art of underwater environmental engineering.

Simcoe Engineering Limited celebrated its tenth anniversary in 1984, growing from a small initial group, to a company with a staff of twenty-five, with ten engineers.

Some of the firm's earliest work was for the Ontario Ministry of the Environment and included the Brechin water plant and distribution system. Later, the firm worked on the design report and design of the Burlington water plant which, at a value of $12 million was a major project for the company at that stage. That work led to further involvement in the Halton Region, including work in the sewerage field, as well as advanced computer-based control systems. Gradually, Simcoe Engineering's client list grew to include a number of Federal government departments, Provincial ministries and many municipalities, including most of the Regions.

After starting in rented accommodation in the Sheridan Mall in Pickering, the company moved in 1978 to its own building on Kingston Road.

Progressively, the company became increasingly involved in sewerage-related projects, including treatment facilities such as the $3.6 million Pembroke Sewage Treatment Plant, and pumping stations, pipelines and sludge management. In this latter area, a particularly significant project has been the development of an automated municipal sludge management system. This program, designed to be operated on a micro-computer, provides for the complete management of a complex system of disposal of sludges on agricultural land. By so doing, disposal costs are minimized and the fertilizer value of the sludges is captured.

In 1983, Simcoe Engineering created Simcoe Instrumentation & Controls, as a separate division of the company. This division undertakes problem diagnosis of existing systems, followed by a variety of services, including equipment selection and installation, fault detection and commissioning. Projects are undertaken jointly with clients who carry out most of the field work, while the Simcoe organization provides design, project management, and field services.

Pollutech Limited commenced operations as a different type of environmental consulting company in 1969. Founded by Dr. J. D. Norman, then an associate professor of chemical engineering at McMaster University, the firm's initial purpose was to provide custom treatment process design information to consulting engineers and to industries for effluent waste treatment. Within a short time, the firm was involved in

a wide variety of other industrial environmental problems from air pollution, product recovery, plant operations tune-ups, to occupational health, safety, and industrial hygiene.

Describing the differences between Pollutech's type of consulting and other established firms in the field, Dr. Norman stated, "in the past 10 years I've observed a wide variety of problem solving techniques available in academic circles that have never been applied in routine practical applications. We are going to set up a facility, with the research capability of an academic type laboratory, to provide a custom problem solving approach on environmental problems for practical use by practising engineers and industrialists."

The company subsequently expanded to Vancouver in 1972 and to Sarnia in 1974.

In its first 15 years of operation, Pollutech Limited has been involved in effluent treatment, air pollution, and other environmental problems in a wide variety of industries including: petrochemical, forest products, iron and steel, food canning, chemical specialities manufacturing, mining, agriculture, grain, shipping, light manufacturing, automotive, and heavy chemical fields. In addition, municipal treatment plant work in major regional or metropolitan municipalities has been undertaken for several dozen treatment plants involving: tune-ups, optimization, or evaluating of limiting capacity for design and expansion purposes.

The company's head office has remained in the same building in Oakville since 1969. Early in 1984, Richard Laughton, Vice President, became a principal in the firm, after nearly five years in a senior management and technical role.

In 1955, **T. W. Beak**, a biologist who pioneered the use of benthic organisms as pollution indicators, opened a consulting firm in Collins Bay, Ontario, called TW Beak Consultants Ltd. At the time, it was one of two biological consultants in North America. Subsequently, a chemical laboratory was established in the basement of his house to provide chemical back up for the water quality surveys. The value of these "in situ" studies and the innovative approaches utilized were exemplified in an award-winning paper published in 1959 in "Sewage and Industrial Waste" concerning the use of benthic organisms and bivariate control charts to assess the efficiency of a pollution prevention program at CIL's Millhaven Plant.

Initially, the firm specialized in pollution abatement for the pulp and paper industries. It has undertaken most of the river assimilation studies in Ontario conducted by the private sector and was a pioneer in the design of primary and secondary mill treatment facilities in Canada. In 1962, it expanded, extending its environmental and engineering services to mining, metallurgical, chemical, power generating, and food processing industries. In 1966, the company became associated with the Sandwell group of companies and remained an affiliate until 1982 when it merged with IEC International Environmental Consultants Ltd. forming **IEC Beak Consultants Ltd.**, an employee-owned company.

The company's commitment to the environment has been demonstrated by sponsoring the Environmental Improvement Award of the Chemical Institute of Canada. This award has been presented annually since 1975.

Today, the firm has 180 employees located in six cities in Canada, and three in the United States. It offers a full range of environmental services including impact assessment, aquatic and terrestrial ecology, fisheries and resource management, analytical chemistry, water quality and process design engineering, and socio-economics. While the majority of IEC Beak's work is strongly mission-oriented, an increasing amount of fundamental research and development is being undertaken in process engineering and biology.

The present day firm of **Underwood McLellan Ltd.** was established in 1911, in Saskatoon as a partnership under the firm name of McArthur & Murphy. In the fall of 1911, the firm undertook its first water and sewerage project for Melfort, Saskatchewan, where a steam-powered trenching machine was utilized for the installation of the mains and the treatment process included primary settling and trickling filters at a total cost of $150,000. Mr. J. E. Underwood joined the new company prior to the opening of its first office and Mr. R. B. McLellan joined the firm in the fall of 1912. The partnership continued under the name Underwood & McLellan until 1952 when it was incorporated. Reorganization in 1977 established the UMA Group and its operating companies, of which Underwood McLellan Ltd. is a member.

The consulting firm expanded to its present staff size of about 600, with the establishment of branch offices throughout Canada and in the U.S. The Toronto branch office was established 25 years ago. Their experience has ranged from Caribbean Islands projects to Baffin Island, in addition to projects in Ontario. Philosophically, the firm has attempted to design the simplest operational process for each particular application to achieve ease of operation.

The largest completed project in Ontario was the Sudbury sewage treatment plant at 2200 m^3/d. The project included a 10 km interceptor sewer tunnel, 30 metres below grade, in addition to the plant which was based on the step activated sludge process without the use of primary sedimentation. Other projects have included plant expansions in Dundas, Waterdown, Markham and Bracebridge, some of which have incorporated effluent filtration for effluent polishing.

Typically, wastewater treatment plant sites have poor soil foundation conditions and, in the case of the Lagoon City plant, gradual preloading of the peat to achieve compaction for the construction of an earthen aeration cell was successful and it was not necessary to remove the peat. The secondary settling tank and plant building was founded on a piled foundation.

The firm has experienced public reaction against recommended projects and in the case of one, this went as far as the public sinking "coffins" into the receiving waters to demonstrate what they perceived would occur with the continuation of the plant effluent disposal into the protected marshy area. Fortunately, the project went forward and has enabled the continued development of the community.

Increasingly, attention is being directed to the control and management of excess storm and sanitary sewage flows. The City of Toronto Memorial Park 9,000 cu.m. storm water tank, located 5 metres below grade, was implemented by UML and the design of the 85,000 cu.m. Greenhill tank in Hamilton has been completed for the Region of Hamilton-Wentworth.

CHAPTER FOUR

EQUIPMENT SUPPLIERS AND MANUFACTURERS

Dorr-Oliver Canada Limited had its origins in 1867 when Mr. Robert Brammer purchased a small foundry and machine shop in Orillia, Ontario.

The firm was soon producing a variety of iron and wood-working machinery such as steam engines, boilers, grist mills, saw mills, etc. During this early period, Mr. Brammer produced many inventions and patents, among these being the celebrated "Clipper" shingle machine which was extremely successful, with sales far exceeding expectations.

In 1894, Mr. Brammer died and his son-in-law, Mr. E. Long, took over the management of the company, with a partner, under the name of Long and Thompson. At the turn of the century, a new company was incorporated under the name of the E. Long Manufacturing Company Limited and it soon felt an increasing demand for its products early in the 1900's. The products were extended to cover the entire wood-working field.

In 1911, the E. Long Company became associated with the Dorr Company of New York City, manufacturing new products such as the Dorr Classifier, Thickener and Agitator for the Canadian market.

During the 1920's, when there was a great surge of development in northern Ontario, lumber began to take second place to the mining industry; in particular, gold and base metal mines were opening up everywhere. Mining machinery and materials-handling equipment were developed and, by 1927, this equipment had become a major part of the E. Long Company's activities.

In 1930, an agreement was made with Oliver United Filters Incorporated of Oakland, Calfornia, for the manufacture of vacuum filters. This was extended in 1940 to include marketing rights as well as production in Canada. In 1954, the Dorr Company and Oliver United Filters were amalgamated to form Dorr-Oliver Incorporated, based in the United States.

The post-war period saw the beginning of a series of expansions at the manufacturing plant in Orillia, Ontario. The plant had produced a major portion of the shaft and mill equipment used in the large mining and pulp and paper industries throughout Canada and, also, process equipment for sanitary waste treatment plants. Expansion of the facilities was necessary to handle the larger equipment requirements needed by these industries. In addition to manufacturing facilities, the staff of the sales engineering department was increased, and sales offices in Montreal, Toronto and Vancouver were established.

In November 1955, the E. Long Company became a wholly-owned subsidiary of Dorr-Oliver Incorporated of Stamford, Connecticut, and the name of the company was changed to Dorr-Oliver-Long Limited.

In May of 1978, the Company name was again changed to Dorr-Oliver Canada, symbolizing the fact that the distinguished E. Long name, associated with the corporation since its inception, had finally disappeared.

In 1914, the Dorr Company of New York City loaned a small thickener to the Sanitary District of Chicago for experimental purposes and subsequently was the first to introduce a lighter torque version of this machine to sewage treatment. Thus, a market was initiated for the Dorr Clarifier, the first sales of which were registered at the Springdale, Massachusetts sewage treatment plant in 1919. In the early 1920's, E. Long Limited began to manufacture Dorr clarifiers for the newly-emerging sanitary market across Canada. Some of the earliest clarifiers were installed at St. Thomas, Ontario; Edmonton, Alberta; Scarborough, Ontario; City of Toronto and Aurora, Ontario. Some of these early installations, dating back to the 1920's, are still in operation at sewage treatment plants today.

At the present time, Dorr-Oliver Canada is solidly established in the municipal and industrial wastewater treatment equipment industry. In this field, Dorr-Oliver Canada is a leader in the supply of clarifiers, digesters, degritting systems and sludge treatment systems, including the well known FluoSolids incineration system. In sedimentation, they have pioneered the squarex clarifier and, latterly, the aluminum bridge clarifier mechanism. The latest 'state-of-the-art' technological equipment has been supplied by Dorr-Oliver Canada for such municipal installations as Kitchener, Waterloo, Duffin Creek and the Lakeview sewage treatment plants. The Duffin Creek and Lakeview Sewage Treatment Plants have recently started operation of their Dorcan FluoSolids Incinerators which incorporate heat recovery. At the Duffin Creek site, Dorcan supplied the secondary digesters, secondary clarifiers, detritors, and two FluoSolids Incinerators with state-of-the-art energy recovery systems. At the Lakeview site, Dorcan have supplied two FluoSolids systems each of which includes a combustion reactor, steam boiler, and gas cleaning scrubber.

In current anaerobic digestion technology, Dorr-Oliver Canada is introducing into Canada three new high-efficiency biological treatment systems - Oxitron, Anitron and MARS - for the treatment of very high strength wastes.

In 1884, Nathan Rosenblatt emigrated to Salt Lake City seeking religious freedom. He there established a metal fabricating business. By 1913, this had developed into a foundry and machine shop, which was named "The Eastern Iron and Metal Co." despite its Utah location. Evidently the East carried more prestige - hence the name "**Eimco**".

In the late 1920's, Eimco acquired rights to the underground loader (Rocker Shovel) from inventors Finby and Royle and developed custom fabrication facilities to serve mines in the area, including the fabrication of disc filters. The success of these projects financed development of a complete vacuum filter line which is now sold on a world-wide basis.

About 1949, engineers Kelly and Kiviri established the firm "Process Engineers" as manufacturers' agents. This firm later developed design and sales facilities for water and waste treatment equipment and was acquired by Eimco in the early 1950's. This branch of Eimco's business went on to develop the famous Reactor Clarifier™ line of solids contact precipitation and clarification units which today are used world-wide in the treatment of raw water, sewage and industrial wastes.

Until 1959, Eimco had been represented in Canada by agents, but, at that time, Eimco Process of Canada Ltd. was formed as a wholly-owned subsidiary to sell, manufacture and engineer the products here. Subsequently, in the U.S., Envirotech Corporation was formed by a merger between Eimco and BSP, a manufacturer of multiple hearth furnaces. Subsequent acquisitions included Wemco, and Goslin Birmingham, a manufacturer of evaporators, pressure filters and dryers. Eimco Process of Canada Ltd. was then renamed Envirotech Canada Ltd.

In 1982, **Envirotech Corporation** (including Envirotech Canada Ltd.) was purchased by Baker International Corporation. In 1985, the Canadian Company's name became Eimco Process Equipment Inc. and new capabilities in water and waste treatment were added by the formation of an ion exchange design and manufacturing facility. Today Eimco designs and manufacturers a complete line of clarification, aeration, sludge thickening, sludge dewatering and tertiary polishing equipment for the treatment of municipal and industrial waste streams.

In 1904, Mr. **Francis Hankin** started business in Montreal, importing iron and steel products made in England and Belgium, and then selling these products across Canada. The first sale of sewage treatment equipment was made in July, 1912, to the Guelph Prison Farm in Ontario, making the firm one of the oldest manufacturers and suppliers of environmental equipment in Canada. The first sales of water filtration equipment were made to Carleton Place in 1913 and to Thorold, Ontario, in August of the same year. In 1916, Mr. Hankin incorporated his business as Francis Hankin & Co., Limited.

Following the First World War, the company became active in markets for institutional and municipal incinerators and power plant chimneys. In order to compete in this market, the company developed engineering contracting skills so that it could offer design and build services to potential clients. Hankin designed and built the first large municipal incinerators in Canada for the Cities of Montreal and Toronto in 1922 and 1923 respectively.

Since the end of the Second World War, the company has grown by broadening its participation in environmental control markets throughout Canada and more recently in the United States. In 1972, the company purchased Canadian Waterworks & Ozone Company Ltd., also known as Canozone. In the same year, the company incorporated a wholly owned American subsidiary, Francis Hankin & Co., Inc. to serve as a vehicle for entry to markets in the United States. In 1974, the company incorporated Les Enterprises Hankin Limitee, based in Montreal, to service markets in Quebec in recognition of the political, social and economic developments in the province. Shortly afterwards, the head office operations of the company moved to Toronto.

Throughout this period, Hankin acquired system technology and process hardware through association with leading European and American firms in environmental control markets. In the mid 1970's, Hankin commenced research and development work which continues today. This work has produced new products and new process system know-how which have been well received by the market-place.

Hankin believes it is unique in the environmental control field because the staff comprises scientists, engineers and constructors. They will design and build a complete environmental control system to meet specific performance specifications.

In November 1983, Francis Hankin & Co., Limited became **Hankin Environmental Systems Inc.** and moved to new offices in Scarborough, Ontario.

Wallace & Tiernan became a Limited Company in Canada in November of 1921. Prior to that date, equipment was sold into this country through the company's head office in Belleville, New Jersey.

Some of the names in company records date back as far as 1917. A partial list of earlier users of their chlorinators, feeders and pumps contains names prominent in Ontario's municipal and industrial development:

1917	Abitibi Power & Paper, Iroquois Falls
1918	Strathroy Water Works
1918	Brunnermond Canada (Now Allied Chemical), Amherstburg
1919	Royal Hotel, Wellesley
1919	Abitibi Power & Paper, Espanola
1920	City of Toronto, John St. Water Plant
1920	Dominion Canners, Jordan
1920	Inco, Lady MacDonald Lake Mine
1921	Broadview Y.M.C.A. Pool, Toronto
1921	Portsmouth Penitentiary, Kingston
1922	Swift Canadian Co., Toronto
1922	Gunns Abattoir, Toronto
1922	Harris Abattoir, Toronto
1922	Island Water Plant, Toronto
1922	Rainy River Water Works
1922	Goudreau Gold Mines, Goudreau
1922	Fort Frances Water Works
1923	Thessalon Water Works
1923	Toronto Sewage Plant.

The original operation was housed in rented space in the west end of Toronto, but, in 1952, the head office for Canada and the manufacturing plant was relocated in Scarborough. The firm is still at the same location and two extensions have been added to the building to keep pace with steady expansion in Canadian markets.

In 1969, Wallace & Tiernan and Pennwalt Chemical Corporation, of Philadelphia, merged on a corporate basis in the United States. At that time, the corporate entity became known as Pennwalt and one Division maintained the Wallace & Tiernan name, known primarily as a leading company in the design and manufacture of water and waste treatment process control equipment.

Control and Metering Limited was incorporated as a Canadian company in 1936 as a rebirth of the E. Dean Wilkes Company, which had been formed in 1922, and ended during the depression.

The company was formed to manufacture and import potable water treatment and municipal sewage plant equipment, including venturi flow meters as licensed from BIF of Providence, Rhode Island, sluice gates as

manufactured by Rodney Hunt of Orange, Massachusetts, dry chemical feeders as licensed from Omega Machine Company of New York. Secondary instrumentation, including flow transmitters, recorders and totalizers were imported from BIF; vacuum sludge filters were imported from Komline Sanderson. Metering pumps for liquid chemical addition and chlorinators were also imported from BIF.

The company supplied the main flowmeters at Toronto's main sewage treatment plant which were installed in the mid 40's. It also supplied one of the first sludge vacuum filters installed in North Toronto in the late 1950's.

In recent times, the company has concentrated more on instrumentation and control systems using computers.

As the book was going to press, Hamilton sewage plant was undergoing revamping of its multiple hearth incinerators, with Control and Metering installing a very sophisticated computer control system.

E. Dean Wilkes was president of the company from 1937 to 1964, followed by Ted Kinsinger from 1964 to 1966, Roy R. Kelley from 1966 to 1974, and Terry D. Fahlenbock from 1974 to the present.

During the Second World War, **Charles E. Napier** was in charge of matters related to water supply and wastewater disposal for the Royal Canadian Air Force. Following the War, he joined Consolidated Engines and Machinery Company Ltd., of Montreal, as a sales engineer in charge of their marketing of water and wastewater treatment equipment and systems. Consolidated, in turn, held Ontario and Quebec representation for Chicago Pump Co. of Chicago, Illinois, and national representation for the Simplex Valve & Meter Co. of Lancaster, Penn. Chicago Pump was then a manufacturer of pumps and sewage comminution and aeration equipment, and was later to become a major supplier of all forms of domestic sewage treatment equipment as well as sewage and water pumps. Simplex Valve and Meter Co. was one of the two major U.S. manufacturers of specialized valves and meters for municipal water treatment plants.

In 1949, Charlie Napier left Consolidated Engines and on January 1st, 1950, opened the doors of **Charles E. Napier Co. Ltd.** in Toronto representing Chicago Pump and Simplex Valve and Meter Co. In the later 1940's and throughout the 1950's, he was responsible for the installation of many Chicago Pump package sewage treatment plants and much Simplex Valve and Meter Co. equipment in municipalities and armed forces bases across Canada.

Charlie was joined by his nephew, George Currie, who stayed until 1956 when he left to pursue other ventures. In March of 1957, Charlie was joined by John D. Reid who had been working in India as a sales engineer for a large company and who had always wanted to work in smaller organizations. Charlie died at the end of August 1961, at the height of his career.

Shortly before Charlie's death, Larry E. Yeigh had started to work for Charles E. Napier Co. Ltd. Larry was a former hydraulics lab partner of John Reid's at the University of Toronto, in their final year of mechanical engineering. Larry went to England for further engineering studies on a fellowship at English Electric, followed by several years at Ontario Hydro, before joining the Charles E. Napier Co. Ltd.

John Reid and Larry Yeigh formed **Napier-Reid Ltd.** in April 1962. The company has grown and branched out into many areas of activity within the field of environmental pollution control, principally related to water pollution. The Simplex Valve & Meter Co. was purchased and swallowed up by another company and disappeared in the mid 1960's; Chicago Pump was also purchased by a large organization, but held together until fragmented in the early 1980's, during which time Napier-Reid Ltd. continued to be its representative in Ontario. Other American agencies were added to the Napier-Reid Ltd. list, including Welles Products, Autotrol, Serpentix, Aeration Industries Inc., Roberts Filter Co., and the Mercer Rubber Co. At the same time, Napier-Reid began designing and manufacturing many of its own products for the wastewater treatment field, including package plants, package pumping stations, heat exchangers and many other items.

In 1983, Napier-Reid touched the field of environmental control within nuclear power plants by developing an improved heavy water vapour recovery system for Ontario Hydro. Two units were delivered to their Rolphton, Ontario, plant and, when placed into operation, proved extremely successful. That year also saw the company reaching into foreign markets and taking a contract to design and supply the site services for a major coal terminal in Indonesia. This work covered fresh water supply and treatment, wastewater collection and treatment, fire-fighting pumps, distribution systems and related structures, coal wagon washing and conveyor dust control.

In 1984, Napier-Reid ventured into the field of designing and installing small wastewater treatment systems for customers requesting this service in the province of Ontario, providing total systems responsibility for such projects.

Ames Crosta Mills (Canada) Limited was officially registered in 1958 as a wholly-owned subsidiary of Ames Crosta Mills & Company, Heywood, Lancashire, England, to directly market its products in Canada. This was not the beginning of its activities in Canada. For some twenty years before that, the parent company was represented in Canada by Laurie & Lamb, who maintained offices in both Toronto and Montreal.

Since those early days, many changes have taken place. Firstly, Ames Crosta Mills & Co. in England is now a member of the Babcock International Group and is now officially known as Ames Crosta Babcock, whilst in Canada, Ames Crosta Mills (Canada) Limited, although retaining a corporate entity, has, through the parent company, licensed its technology to **Asdor Limited.** Asdor Limited assumed the Ames Crosta activities in 1973.

Mechanical aeration in the form of the concept of a single-point aerator mounted at the centre of a square, rectangular or circular aeration tank was invented in England by Mr. Joshua Bolton shortly after the commencement of World War I in 1914.

During the years prior to the formation of the Ontario Water Resources Commission, Mr. J. F. Bolton, the son of Mr. Joshua Bolton, who was, at that time, the managing director of Ames Crosta Mills Limited, the parent company in England, was a close friend of the late Dr. A. E. Berry. They, along with others, shared a mutual concern over the public health consequences of untreated sewage and need for positive technical means to achieve a safer environment. At the formation of the Ontario

Early emphasis was on sludge dewatering equipment, sludge pumps and sub-surface aeration equipment for the waste treatment fields, filter box equipment including underdrains, surface washers, washwater piping and troughs for potable water treatment facilities, and chlorination equipment and flow elements for both fields. In 1966, Hugh moved on to form Hugh R. Fielding Limited. After 1966, Fielding Crossman's emphasis was on filter box equipment and flow measurement and regulating equipment.

In 1969, Ian Watson joined the company, following several years' experience with James F. MacLaren Limited and Allis-Chalmers. He became a significant shareholder in the company in 1976.

Presently, the company uses in-house facilities established in 1974 to manufacture its specialty fibreglass products and continues to use outside facilities for metal fabricated products. The company manufactures such products as Venturi flumes, slide gates, weir plates and troughs; it markets and services the products of several U.S., U.K. and West German manufacturers of filter box equipment, specialty valves, sluice gates, glass-lined pipe and measuring devices of all types.

Marketing is handled by its own forces in the province of Ontario and through representatives in other parts of Canada.

The Gray Engineering Group, started in 1972, with Cameron Gray, plus a secretary. The company has now expanded to a staff of 65, with annual sales in excess of $12 million.

While exports now make up a vast part of the Company's business, it was not always that way. Originally, the Company served Ontario as a representative of a number of reputable manufacturers.

Today this line has expanded to include: The Gray/FineAir fine bubble aeration system, Gray/Screwlift Archimedes principle screw pump, Gray/MobilePress belt filter press, Gray/WedgePress dewatering belt filter press, the Gray/ScrewPress screenings dewatering system and Gray/ProPak and Gray/Flocor random and sheet trickling filter media.

The number of principals has also grown. The company is now owned by Cameron B. Gray, James K. Leitch and Gordon M. Weis, all Professional Engineers.

This teamwork contributed to the establishment of a network of representation across North America. It also expanded the scope of the Gray organization that now routinely bids multi-million dollar projects both in Canada and the U.S.

Ontario has always been Canada's largest pollution control market and projects here for Gray have included process equipment supply and supervision to most major manufacturers in Ontario.

In the States, the focus of much sales effort in recent years, Gray made breakthroughs with its screw pump technology, followed by the development of the Gray/FineAir system. Today, many large projects have been completed in Phoenix, Arizona, Philadelphia, Pennsylvania, Newark, New Jersey, Cincinnati, Ohio, Chicago, Illinois, Atlanta, Georgia and in many other cities and states throughout the United States.

Recently the Gray group received public recognition for their export efforts. They were one of only 14 companies to receive the prestigious Canada Export Award for 1984.

T. D. Rooke Associates was formed in 1979 primarily as an exclusive sales agent for Greey LIGHTNIN in the Province of Ontario but quickly grew to encompass an association of many quality equipment manufacturers, also including the William R. Perrin Company, Ultraviolet Purification Systems, C. E. Bauer and Precisioneering Limited.

Greey LIGHTNIN, rated world leaders in mixing technology and a major developer of aeration systems, has installed at Duffin Creek 16 of the largest mechanical surface aerators ever to be installed in Ontario for the treatment of municipal wastewater. It has installed submerged turbines in Canada's first municipal biological phosphate removal plant in B.C. and has installed aeration equipment in Canada's first municipal pure oxygen system in Winnipeg, Manitoba. It is now installing aeration equipment in Ontario's first municipal pure oxygen system in Barrie, Ontario. Complete biological treatment plants have been installed in many small Ontario municipalities such as Dresden, Odessa, and Ailsa Craig.

William R. Perrin Company Limited has been manufacturing sludge dewatering equipment in Ontario since the turn of the century, specializing in the Recessed Plate Filter Press, Membrane Filter Presses, and Belt Filters. Perrin has pioneered many new technologies such as the first Filter Press System for dewatering refinery oily sludges, and the first Recessed Plate Filter for dewatering heavy metal wastes in the U.S. automotive industry. The company co-operated in the development of and supplied the first Recessed Filter Press for oil well completion fluids. It also co-operated in the development of the technology to dewater municipal sludges with Recessed Plate Filters and polymers.

Ultraviolet Purification Systems Inc., has, since the early 1930's, pioneered the development of germicidal Ultraviolet Equipment for the destruction of micro-organisms wherever bacteria-free water is required. UPSI, with its ongoing research program, has refined the technology that now forms today's "state-of-the-art".

In 1967, UPSI installed their first Ultraviolet system for the disinfection of municipal wastewater in lieu of chlorine. They now have many such municipal plants ranging in all sizes up to and including 115 MGPD. A 0.9 MIGD ADF Ultraviolet Purification System is being installed in Collingwood Township, in Ontario.

C. E. Bauer is presently installing the first static, self-cleaning screen, the Bauer Hydrasieve, in Amherstburg, Ontario, for fine screening of municipal primary wastewater.

Precisioneering Limited has been a large contributor of fiberglass reinforced plastic products to the pollution control field. These products include chemical storage tanks, gas scrubbers for odour control, exhaust fans, gratings, walkways, and handrails.

Ontario Pollution Control Equipment Association

The Ontario Pollution Control Equipment Association (OPCEA) is an association of manufacturers, suppliers and other industries related to the water pollution control field.

The OPCEA is a new name for a very mature association. The original equipment association was the Canadian Sanitation Equipment Association and this association was the original counterpart of the Canadian Institute on Pollution Control. But, when regionalization took place in 1971, and the Pollution Control Association of Ontario was formed, the equipment association, instead of serving the whole of Canada, changed its name to the present form and now serves its membership in the province of Ontario.

Surprisingly, over the last 25 years, although a new president is elected each year, the position of secretary-treasurer has only changed three times. The early secretary-treasurer was George Morgan, of the Victaulic Company who was very active and supportive during his term of office, which terminated in the late 1960's. For a period of 10 years, Arthur S. Doran was the secretary-treasurer and was part of the team that was responsible for the transition from the national level to the provincial level. The present secretary-treasurer is Terry Fahlenbock, of Control and Metering Limited.

The years have seen many changes, but probably the most notable change has been the acceptance of the equipment association and its members at conferences, seminars and many other related aspects of the water pollution control field, not only in the province of Ontario, but also throughout Canada.

CHAPTER FIVE

A TALE OF TWO CAPITAL CITIES

Whether judged by national or international standards, **Metropolitan Toronto** must be considered in the forefront for the application of municipal pollution control technology and the construction of facilities. The City of Toronto's first attempts at pollution abatement began over a century and a half ago when a sewer system was installed to serve the original city, according to a report written about 1965 by D. F. McCarthy, a former Director of Engineering for the City of Toronto. As his father, George Arnold McCarthy, was a Sewer Engineer for the City, a condensation of this paper gives some valuable insights into the past.

The City of Toronto was incorporated as a City on March 6, 1834. Its boundaries were Dufferin Street, Bloor Street, the Don River, Queen Street East, Maclean Avenue and Lake Ontario. The history of the sewers prior to this time is buried in antiquity, although it is almost certain that some of the streets in its predecessor, the Town of York, were sewered.

The earliest record is the original copy of a license to connect a private drain to the public sewer on King Street, dated December 7, 1835, so it is evident that a sewer had been constructed on King Street prior to that time.

Most of the sewers of this period followed the European practice of brick construction. Brick sewers, 15-inches in diameter and less have been uncovered during excavation in the older parts of the City. Wood was also used.

The earliest tile sewers were constructed of pipe imported from Scotland. In 1885, the Campbell Sewer Pipe Company was established in Hamilton, and, in 1890, this became the Hamilton Toronto Sewer Pipe Company. The City Engineer's Annual Report of 1891 records that large quantities of tile pipe were purchased from this Company. About 1895, the Ontario Sewer Pipe Company was established in Mimico, now a part of the City of Etobicoke.

The following extract from the City Engineer's Annual Report of 1891 is of interest:

> "Jarvis Street sewer has been reconstructed at the Esplanade and the old stone sewer with an invert composed of planks and cedar logs has been torn up and a brick sewer substituted. The outlet of this sewer which was of sheet piling has been replaced by a 48-inch steel pipe."

The City Engineer's Annual Report also states that:

> "The sewage system of the City is very complete and extensive; its defect lies in the place of discharge into the harbour in front of the City. When this is remedied by the construction of a trunk sewer, that will discharge into the lake five or six miles to the east of the City, Toronto will have an unrivalled system."

In a Report dated 1886, the following sewer outfalls had been listed:

Cherry Street	2'8" x 4'0"	Yonge Street	3'6" x 5'0"
Parliament Street	3'6" x 5'0"	Simcoe Street	4'0" Circ.
Sherbourne Street	2'8" x 5'0"	Brock Street (now Spadina Avenue)	4'0" x 5'6"
Jarvis Street	3'6" x 5'0"	Bathurst St.	2'6" x 3'9"
Church Street	2'8" x 4'0"		

The organic and inorganic solids carried by the sewage settled in the slips in the harbour and had to be dredged annually.

The appendix to the Report of 1886 contains an extract from the newspaper "Patriot" complaining in 1853, of the pollution of the Bay. It refers to the odour of the gases rising and to the contamination of the ice which was harvested for domestic use.

There is no doubt that complaints regarding the condition of the Bay continued, but it was not until 1885 that the City, becoming alarmed at the condition of the domestic water supply, and the frequency of typhoid fever epidemics, engaged the Hon. W. J. McAlpine and Kivas Tully to bring in a report on ways and means to correct the situation. This was the first of many such reports. In a report dated February 15, 1889, Messrs. Hering and Gray, Consulting Engineers from New York, recommended the construction of a high level interceptor at such an elevation that gravity flow could be obtained to the outlet, and a low level interceptor which would require pumping. The outlet was to be in the vicinity of Victoria Park and the only treatment provided was by dilution in the Lake.

This was followed by a Report dated August 30, 1890, from the City Engineer, W. T. Jennings, confirming the recommendations contained in the Hering and Gray report.

Apparently this ended the matter for a period of ten years. In 1901, the City sent the City Engineer, C. H. Rust, to England to investigate biological methods of sewage treatment which were being introduced in that country. On his return, in a report dated July 8, 1901, he agreed with Hering and Gray that no treatment was required, that with such a large body of receiving water available, pollution would not be a problem, and that dilution was a much cheaper form of treatment than other processes.

In the meantime, the Garrison Creek had been enclosed in a sewer and the valley filled. This creek had its source in the hills north of Davenport Road, in the vicinity of Springmount Avenue, whence it flowed south and east, passing through Willowvale Park, then south-west to a point between Ossington Avenue and Roxton Road (then Givens Street) north of Harrison Street and then south-east to the waterfront between Fort York and Bathurst Street. The north-west branch rose near Bloor Street and Brock Avenue and flowed south-east to join the main stream east of Ossington Avenue. In 1884, contracts were awarded for the sections from the Bay to Wellington Street, from Wellington to Queen Street, and from Queen Street to College Street. In 1887, a contract was awarded for the section from College Street to Bloor Street, followed in 1890 by a contract for the north-west branch. This sewer

served as an outlet for a large area in the west central part of the City and its construction and subsequent filling of the valley opened a large section of the City for development.

The original boundaries of the City had remained unchanged in the 49 years since incorporation. Then, in 1883, Yorkville was annexed to the City, quickly followed by Brockton, Riverdale, Rosedale, the Annex, the area between Bloor Street and the C.P.R. west to Indian Road, and Sunnyside and Parkdale, among other smaller annexations.

This, then, was the situation at the turn of the century in the City of Toronto. The trunk sewers on the main streets discharged into the Bay. The Garrison Creek sewer had been completed and also discharged into the Bay.

There had been a lot of talk and many reports on the subject of sewage treatment but no action had been taken. The population was increasing, the boundaries were spreading and the quality of the raw water for domestic use was becoming critical.

Thus matters stood for several years. The City Engineer, C. H. Rust, had been advocating a dilution scheme for sewage treatment essentially the same as Hering and Gray had recommended in 1889, except that the outfall was to be at Ashbridge's Bay instead of Victoria Park. He also recommended sedimentation tanks to remove the heavier solids before discharging to the lake.

Toronto, in general, was then served by combined sewers. Many of the sewers were built by outlying communities which were absorbed later by the City, rather than as a part of a general plan and, when such districts were absorbed, it was generally found that the sewers were quite inadequate and, in some instances, had to be scrapped. Storm overflow sewers discharged into the Don River, Lake Ontario, Toronto Bay and Ashbridge's Bay.

Complaints were made of the foul condition of the slips at the water front, resulting from the discharge of sewage near the shore. Such complaints led to the extension of some of the outlets.

In 1908, the City Engineer reported three to four feet of sewage sludge covering the bottom of the bay. About 20,000 cubic yards of sludge deposits were removed annually from the bay slips, until 1913.

The collection and disposal of the sewage in such a way as to alleviate pollution of the bay and shore waters had been recommended in 1889 in the Hering and Gray report which presented preliminary plans for a system of intercepting sewers and sewage disposal works. The intercepting sewers were built between 1908 and 1912, in substantial accordance with their recommendations. The Eastern Avenue works were built during the period 1910 to 1912, following a report dated March 6th, 1909, by Messrs. Watson and Hering, consulting engineers, who reviewed the earlier engineering investigation.

The works built in accordance with these reports consisted of a high level intercepting sewer, a low level intercepting sewer, sewage pumping stations, a sewage treatment plant and a lake outlet conduit.

The Main Treatment Plant was situated south of Eastern Avenue and west of the Woodbine (now Greenwood) Race Track. It was placed in operation in March, 1913, when treatment consisted of plain sedimentation. It was the evident intention of the designers to provide a sedimentation period of some three hours at an average flow of 33 million gallons daily. The late Ross Clark referred to these as Imhoff Tanks, as do other Metro Engineers. However, Douglas McCarthy researched old data as recently as 1984, yet could find no evidence that they were Imhoff Tanks.

The location of the Eastern Avenue plant had been opposed in 1908 by the residents in the neighbourhood. Several actions for damages were entered against the City after 1915, on account of alleged nuisances said to have resulted from the operation of the plant. The first case, that of Fieldhouse v. Toronto, in 1918, was decided in favour of the plaintiff, to whom damages were awarded.

Even as late as 1931, the court heard the cases of Woodcock v. Toronto and Spencer v. Toronto. The cases were decided in favour of the plaintiffs and damages awarded them by the trial judge. The judge also ordered an injunction to prohibit the City from operating the plant in such manner as to constitute a nuisance to the plaintiffs. A stay of execution of three months was allowed. The case was taken to the Court of Appeal and the judgment upheld, except that the suspension of the injunction was ordered continued for one year from the date of judgment of the Court of Appeal, that is until January 11th, 1933.

By the end of 1910, further annexations had taken place including East Toronto, Midway and Balmy Beach in the east, North Rosedale and Deer Park in the north, and Wychwood, Brawndale, West Toronto, Dovercourt and Earlscourt in the west.

Shortly after each annexation, the City constructed a system of trunk and local sewers to serve the area and permit development. For example, the Midway was annexed in 1909 and the trunk sewer to serve this area was constructed in 1914. East Toronto was annexed in 1908 and, by 1913, three trunk sewers were under construction. West Toronto, which joined the City in 1909, had a system of sewers, but, by 1913, the City had constructed a system of trunk sewers to carry the sanitary wastes from this area to the treatment plant.

Meanwhile the Garrison Creek sewer had become seriously overloaded. In 1912, an overflow sewer was constructed from the junction of the north-west branch with the main sewer to the lake at the foot of Strachan Avenue. Further relief was provided in 1914 by the construction of a parallel sewer from the same point northerly to Bloor Street.

Another important development in the City took place between 1924 and 1930. This was the elevating of the railway tracks south of Front Street and the creation of a large area of new land by hydraulic dredging. Streets were laid out on this land on which was constructed a separate system of sewers. The storm sewers discharged to the Bay, but the sanitary sewers, being too low for a gravity connection to the Low Level Interceptor, discharged to the wet well of a pumping station at the foot of Scott Street from where the sewage was pumped to the Low Level Interceptor on Front Street.

Another part of the City which was earlier sewered with a separate system is east of Woodbine Avenue, south of Queen Street. Sanitary sewage from this area was conducted to a septic tank in the beach at the foot of Woodbine Avenue, which served until the Main Treatment Plant was placed in service in 1913. Shortly thereafter, a pumping station replaced the septic tank and the sewage was pumped up Woodbine Avenue to the trunk sewer on Kingston Road. This station was abandoned in 1952 when the Lakefront Interceptor was constructed to carry this flow by gravity to the low level pump well at the Main Pumping Station on Eastern Avenue.

The Town of North Toronto was annexed to the City in 1912. Its population was about 5,000 and it covered an area of a little over 2,700 acres. It was sewered by a system of sanitary sewers, with three inadequate treatment plants. It was soon realized by City officials that no part of the system was adequate for ultimate development and, therefore, it was decided to resewer the whole area. A deep ravine formed the southern boundary which precluded the possibility of a connection to the existing City system, so an independent system was selected to discharge to a new, efficient, treatment plant. Consideration was given to both a combined system and a separate system and comparative estimates were proposed. The combined system was adopted on the basis of lower cost. However, World War I intervened, and the proposal met strong opposition from the ratepayers, so it was not until 1925 that City Council approved the two local improvement recommendations, one for trunk sewers and outlets, and the other for the local sewers. The cost of construction was assessed against the benefiting property owners under the Local Improvement Act. The same year Council appointed Dr. George Nasmith of Toronto, and Harrison Eddy of Boston, to recommend an appropriate method of treating the sewage. The Nasmith Eddy report, dated April 3, 1926, recommended an activated sludge plant in the Don Valley.

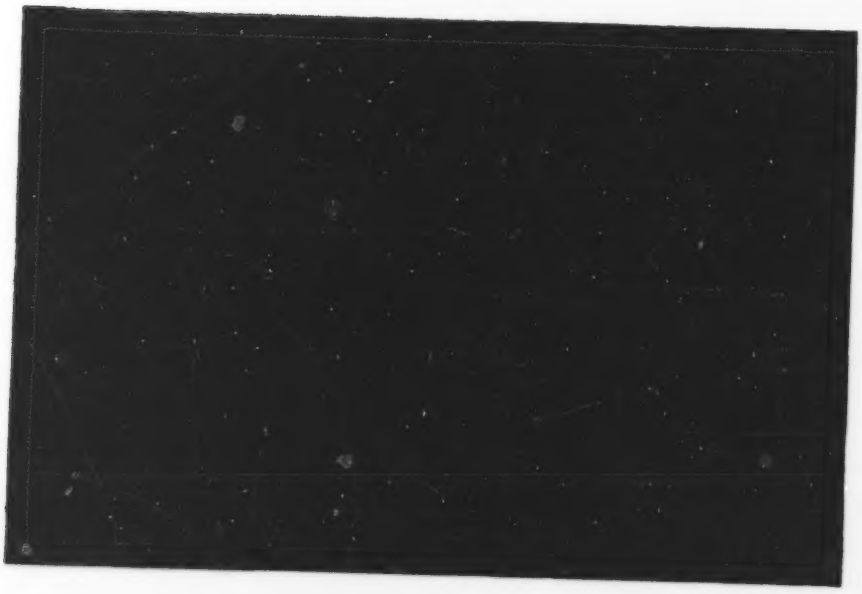
The Town of Leaside and the Village of Forest Hill both had small sewage treatment plants. By agreement with the City, these plants were abandoned, and the sanitary sewage diverted to the North Toronto Plant which was destined to become the city's first activated sludge plant.

The main sewer from the North Toronto district extended south-easterly to a shaft, having a vertical drop of 90 feet at the treatment plant. From the bottom of the shaft, the main sewer extended to the Don River, a short distance downstream from the (then) Thorncliffe Race Track. The sewage to be treated was diverted to the treatment plant from the main sewer at a point near the drop shaft.

The North Toronto plant was built in the late 1920's when R. C. Harris was Commissioner of Works. It provided activated sludge treatment, originally designed for a population of 50,000, before later being enlarged to serve 100,000 persons. It comprised eight major features: racks, grit chambers, preliminary sedimentation tanks, aeration tanks, final sedimentation tanks, storm water standby sedimentation tanks, sludge digestion tanks and glass-covered sludge drying beds.

In the meantime, the treatment plant at Ashbridge's Bay (sedimentation tanks) had become seriously overloaded. In 1931, City Council appointed Gore, Nasmith, and Storrie of Toronto, in collaboration with Metcalf and Eddy of Boston, Consulting Engineers, "to make thorough investigation of the sewage disposal problem and to prepare a written report thereon"

Leaside* "Disposal Works" November 5, 1928
City of Toronto Archives, Works Department #1019
(*Better known as the North Toronto Plant)



Leaside * "Secondary Tank" April 19, 1932
City of Toronto Archives, Sewer #1340

with specific instructions that the plant should not be located on Eastern Avenue at the site of the (then) existing Main Sewage Disposal Works.

The preparation of this report took over two years and was finally submitted on November 2, 1933. The salient recommendations may be summarized as follows:

1. That provision should be made for treating the sewage from areas outside the City which may seek such facilities.

2. That the plant be planned for a population of 1,564,000 by 1970.

3. That the existing plant be eliminated.

4. That a new activated sludge plant be constructed at the mouth of Highland Creek.

5. That a pumping station be constructed at the site of the existing plant to pump the sewage to the new plant.

6. That an additional high level interceptor be constructed to relieve the present interceptors.

The estimated cost of $10,233,00, for the pumping station and outfall sewer to Highland Creek, coming as it did during the severe economic depression, caused City Council to have second thoughts about the location of the plant. On October 25, 1934, Council requested the consultants to bring in a supplementary report with no restrictions as to location. The supplementary report presented on July 27, 1935, recommended the construction of an activated sludge plant at the location where the Main Treatment Plant stands today.

However, construction was delayed, apparently by Council's concern for the cost of the plant. On May 1, 1939, Council appointed five prominent sanitary engineers as a Board of Review "to study and report on the conclusions of the consulting engineers as expressed in their report to the City dated July 27th, 1935.....and to advise, having regard for local conditions, if the form of complete treatment recommended by the said consultants is in their opinion necessary, or if in the alternative, some modified or other form of treatment would be sufficient to adequately protect the citizens."

This Board presented its report to the City on September 22, 1939. Four of the members signed a majority report, whole-heartedly endorsing the recommendations of the consultants. One dissenting member wrote a minority report, recommending elimination of the aeration stage and depending on dilution for the final treatment.

Once again, a World War, and the resultant shortage of men and materials delayed construction. It was not until after the cessation of hostilities that the first contract was let.

The provincial Department of Health, which was the controlling body at that time, permitted the City to proceed in two stages. The first stage was to include primary settling tanks with digestion and incineration of the accumulated sludge. The second stage, to be undertaken within a

stated period of time, was to add the aeration tanks. The Main Treatment Plant became Canada's largest wastewater treatment plant and, through constant expansion, remains the nation's largest activated sludge facility, with a current capacity of 180 MIGD.

In 1953, the Province of Ontario took a bold step when it enacted the Municipality of Metropolitan Toronto Act. It is described in a 1958 MacLaren report as "an act unique in the history of legislation regulating municipal government."

The Act provided for a federal system of municipal government in which all thirteen area municipalities retained their autonomy in respect of local matters, but in which each achieved representation on the Metropolitan Council which became responsible for the provision of services, considered by the Act to be Metropolitan in nature.

Among the most important requisites for the passing of the Act was "providing for the federation of the municipalities in the Toronto Metropolitan Area for certain financial and other purposes." The importance of the word "financial" cannot be over-emphasized. Prior to the establishment of the Municipality of Metropolitan Toronto, many of the area municipalities, lacking in industrial and commercial assessment, experienced financial difficulty in raising sufficient taxes for current expenditures, and in particular, in selling debentures. The exclusive power given to the Metropolitan Corporation to issue debentures for purposes, not only of the Metropolitan Corporation, but also for the purposes of the area municipalities and their Boards of Education, relieved this situation. As such debentures were direct, joint, and several obligations of the Metropolitan Corporation and the area municipalities, they were more readily accepted by the bond market than were those of the area municipalities, with the exception of the City of Toronto.

Accordingly, the exclusive debenturing power of the Metropolitan Corporation made possible the development of a Metropolitan Capital Works Programme for the next ten years, and the integration of that program with the anticipated capital requirements of the area municipalities and their Boards of Education.

One of the main purposes, other than financial, for the formation of the Metropolitan Corporation, was the co-ordination and improvement of water and sewage works throughout the Metropolitan Area. Accordingly, when the actual administrative operation of the new Metropolitan Corporation was initiated on January 1st, 1954, the Metropolitan Department of Works was formed to become responsible for the following functions:

1. The production, treatment and supply of water to the distribution systems of the 13 area municipalities.

2. The collection of sanitary drainage from each of the 13 area municipalities and its treatment prior to discharge into receiving waters.

3. The accommodation of certain surface water, which is considered a Metropolitan responsibility.

4. The control and elimination of atmospheric pollution (later, this function was taken over by the Province.)

5. Miscellaneous engineering problems, applicable to more than one area municipality.

In order to implement its duties and to commence its works as soon as possible, the Metropolitan Council authorized the Department of Works, through its Commissioner, to engage the firm of Gore and Storrie Limited, to immediately bring up to date a previous report on water supply and sewage disposal and drainage for the Metropolitan Area. This revised report, dated January 30th, 1954, formed the basis of a comprehensive improvement program, and reported on conditions in the sewage works:

> The North Toronto plant was treating a sewage flow considerably in excess of its design capacity and despite the plant's age, it was still producing a reasonably good effluent, with approximately 90 percent of the suspended solids being removed, and a slightly less amount of BOD. The Main Plant was providing primary treatment to practically 90 percent of the sanitary flow originating within the City of Toronto, with approximately 50 percent of the suspended solids being removed and the effluent being discharged at depth into Lake Ontario.
>
> In Scarborough, the Pharmacy Sewage Treatment Plant, an aged activated sludge plant which had been enlarged, was accepting sanitary flow from the western portion of that Township, providing only 70 percent removal of suspended solids. Sewage from the remainder of the Township was generally handled on a private septic tank basis.
>
> The Township of East York was operating the Todmorden and Danforth Park Plants, both of the early activated sludge type and discharging their effluents to the Don River and its tributaries, as was the Pharmacy plant. Both plants were and had been for a considerable number of years, severely overloaded, providing only a 55 percent removal of suspended solids.
>
> The Township of North York was operating six small sewage treatment plants, all of the activated sludge type and of relatively modern design. They were providing 87 to 94 percent removal of solids. With the exception of the Glendale, Gwendolyn and Armour Heights plants, which discharged their effluents to the Don River, these plants discharged their effluent to a tributary of the Humber River - Black Creek. Despite the number of plants located in North York, they served less than 50 percent of the Township's population, and were rapidly becoming overloaded. A seventh plant, Don Mills, (activated sludge type discharging to a branch of the Don River) was under construction by a development company, and an eighth plant, (activated sludge type discharging to Black Creek) had only recently been established by the Royal Canadian Air Force for its development at Downsview. Small sections of the Township of North York were served by connections to the sanitary sewerage systems in the Townships of York and East York, in the City of Toronto and in the Town of Weston. These systems were providing sewage treatment accommodation

through municipal agreements. However, an extensive portion of the population of North York was served only by septic tanks which were proving to be generally unsatisfactory, due to the soil conditions in the area.

The Weston Sewage Treatment Plant, a high rate trickling filter plant discharging its effluent to the Humber River, had recently been enlarged to accommodate the Town of Weston and parts of the Townships of North York and Etobicoke. Although the plant was effecting moderately good treatment at the time, it was obvious that the rapid development in the areas of North York and Etobicoke draining to the plant would soon create conditions of overload.

In the Township of York, the sanitary flow from another generally combined sewerage system flowed, by gravity for the greater part, to an aged activated sludge plant on Rockcliffe Blvd. for treatment prior to discharge to the Humber River. Flow from the concentrated population of this municipality so overloaded this plant that a removal of suspended solids of less than 40 percent was effected.

The Swansea Village Treatment Plant, an early activated sludge plant discharging effluent to the Humber River, was accepting more sewage than it could accommodate, with the result that only 70 percent of the solids were being removed.

Sanitary sewage from the southern portion of Etobicoke Township was treated at the recently constructed Etobicoke Township Sewage Treatment Plant (activated sludge type) situated on Mimico Creek and discharging effluent to nearby Lake Ontario. The area draining to it was only partially developed and, as a result, it was not overloaded and provided efficient treatment. However, development in the area tributary to this plant was proceeding at a rapid rate and there were indications that the plant would soon become overloaded, if additional facilities were not provided. Small areas of the Township drained to the Mimico and Long Branch systems under municipal agreement.

The Towns of New Toronto and Mimico were accommodated by the Union Sewage Treatment Plant, an early activated sludge plant, situated in Mimico and discharging effluent to Mimico Creek. Due to a heavy sanitary flow containing extensive amounts of industrial waste, this plant had been severely overloaded for a number of years.

The Long Branch Sewage Treatment Plant, an early activated sludge plant, discharging effluent to Lake Ontario and serving the Village of Long Branch, a small section of the Township of Etobicoke, and limited areas in Toronto Township, was accepting sewage well above its capacity, with the result that only 48 percent of the suspended solids were being removed.

In carrying out their study of 1954, the consulting engineers found that both the Don and Humber Rivers were badly polluted. Bacterial counts reached over one million per 100 millilitre sample in the lower reaches of each river, and flows were found to contain excessive amounts of suspended solids and oxygen demand. Further, it was obvious that the pollutional load had been increasing rapidly in the years since the war as the populations throughout the drainage areas also expanded at a rapid rate. While the reduction of pollution in these rivers to a level that would permit bathing at all times did not appear feasible, some substantial reduction of pollution was necessary to safeguard the public health. Such pollution levels were affecting raw water supply to the Area's filtration plants on Lake Ontario and the requirements of the Ontario Department of Health were not being met. In addition, the planned construction of roadways in the valleys of these rivers, the use of riparian lands for parks and the rivers for boating necessitated the elimination of all unsightly conditions and odours from the waters. In order, therefore, to limit the bacterial count in these streams to the maximum recommended by the Ontario Department of Health, an m.p.n. count of 2400 per 100 millilitres, it was obvious that all normal disposal of sewage effluents to these streams must be eliminated, thereby limiting pollutional discharge to the occasional overflows from storm or combined systems.

On this basis it was recommended that all plants on the watersheds of these two rivers would ultimately have to be abandoned.

In establishing new sewage treatment plants of larger capacity along the lakefront, the matter of the degree of treatment required came under review. It should be pointed out that under date of January 23rd, 1940, the Ontario Department of Health issued a Certificate of Approval No. 40-A4 for the construction of the sewage treatment plant which is now in operation at Ashbridge's Bay, known as the Main Sewage Treatment Plant, then owned by the City of Toronto. The Certificate stated that:

> "the Department recognizes this proposed plant as the first stage of a complete treatment process"
>
> and
>
> "that the final stage of the complete treatment plant will be undertaken within four years of the completion of this first stage."

On the basis of this statement, and also in view of the development of major water treatment plants across the waterfront, both in the past and proposed in the future, it became obvious that the establishment of any central plants for purposes of sewage treatment in the metropolitan area, with disposal of effluent to the lakefront, must be based on supplying complete treatment and all programs were instituted accordingly.

As a result of these recommendations, a capital works program to provide the metropolitan area with adequate sewage treatment plants and sanitary trunk sewers to convey the sewage to them, was adopted by the Metropolitan Council. In general, the scheme embraced the establishment of major treatment plants at the mouths of the large rivers of the metropolitan area, with sanitary trunk sewer systems extending northerly from each plant for collection purposes. Extension and improvements to

certain existing plants were also included, although it was recognized that eventually they would be abandoned.

In April of 1954, the Metropolitan Council authorized the Department of Works to appoint engineering consultants. Accordingly, the firm of James F. MacLaren Associates was appointed "to supply all engineering services incidental to the development of the work to accommodate and treat the sanitary drainage from the entire Humber River watershed within the geographical limits of the Metropolitan Area as designated by the Commissioner of Works." In carrying out its commission, this firm consulted with the firm of Alvord, Burdick and Howson of Chicago, Illinois.

The watershed of the Humber River, including its tributaries within the limits of the Municipality of Metropolitan Toronto, includes an area of some 34,200 acres, representing six municipalities, namely a portion of the Township of North York, practically all of the Township of York, the Town of Weston, the Village of Swansea, the greater portions of Ward 6 and all of Ward 7 of the City of Toronto and a large portion of the Township of Etobicoke. Studies of the areas tributary to the proposed treatment plant indicated that they were somewhat more extensive than the actual area of the watershed, due mainly to existing and proposed development of the sewerage systems of the various included municipalities, which at certain points extended for some distance beyond the watershed's limits.

With particular reference to the Township of Etobicoke, it was obvious that eventually the trunk sewer discharging sewage for treatment to the Etobicoke Sewage Treatment Plant would have to be diverted to discharge its flow to the new plant, and that at such time it was quite probable that sewage flows from the Towns of New Toronto and Mimico would be similarly diverted. It was also considered that sewage flows from a limited area of the watershed beyond the northern limits of the Metropolitan Corporation would have to be provided for at the Humber plant in order to ensure that no future sewage treatment plants would be established on the Humber River or its tributaries within, say, one half-mile of the Metropolitan limits.

From these studies, therefore, it became evident that the ultimate tributary area from which sewage would be discharged to the Humber Sewage Treatment Plant could be some 50,000 acres or approximately one-third of the Metropolitan Area, and would have an estimated ultimate residential population of at least 800,000 persons.

Construction on the project was commenced in September 1955, with the award of the first rough grading contract, and was followed in November of that year by the award of the contract for constructing the shore section of the plant outlet sewer. All preliminary grading and the shore section of the outlet were completed by late fall of 1956.

In October and November of 1956, contracts were awarded to Canadian Fairbanks Morse Co. Ltd. for the supply and installation of return sludge return pumps, to Combustion Engineering-Superheater Limited (Delaval) for the effluent flushing pumps and to Orenda Industrial Limited (Roots Connersville Blower, National Gas Engines) for supplying and installing air blowers, gas engines and auxiliaries.

In January of 1957, Pigott Construction Limited was awarded the first general contract on the project, which involved the construction of the sedimentation and aeration tanks and related structures at a cost of $5,837,000. At the same time, contracts were awarded to Dearborn Chemical Company Limited (Walker Process Equipment) for the supply and delivery of primary tank collector mechanisms and to Dorr-Oliver-Long Limited for the supply and delivery of final tank mechanisms. This first general contract was completed in May of 1959.

The award of the second general contract was delayed until January 1958, when Pigott Construction Limited received the contract in the amount of $4,459,000, for the construction of the Main Building, digestion tanks and related structures.

By the end of 1958, the Metropolitan Corporation had expended $36 million dollars in the carrying out of sewage treatment construction.

In September, 1959, the Committee on Public Works requested that a report be prepared on a replacement program for the City of Toronto's sanitary and storm sewers, the number of years this would take and the extent to which the Metropolitan Corporation would be required to share the cost. Accordingly, James F. MacLaren Associates, Consulting Engineers, were commissioned to make the necessary study and submit the required report. This report, dated December, 1960, included the following recommendations.

- Complete separation of storm and sanitary sewers was not warranted in view of the prohibitive cost.
- Partial separation by means of "road" sewers.
- Increase in the design rainfall rate.
- Diversion of sanitary sewage from the Keele, St. Clair area to Humber Waste Water Treatment Plant.
- Construction of a high level relief sewer as originally advocated in 1933.

They also concluded that "the general status of the City's sewerage system can be considered adequate insofar as the major trunk sewers are concerned, but of doubtful adequacy with reference to neighbourhood or lateral street sewers."

The Department adopted the recommended design criteria and embarked on a program of road sewer construction.

Metro Toronto's program preceded that of most American and Canadian cities and established a model for others to follow.

More details of today's modern plants which serve Toronto are found in the **Projects** chapter.

The Nation's Capital

Ottawa in 1994 bears little evidence that the nation's capital was once a squalid, disease-ridden place.

The provision of a water works system for Ottawa was not without its development pains.

The residents of Ottawa were originally supplied from two wells, one in Lower Town and the other in Upper Town at the corner of Wellington and Kent Streets. These supplies were supplemented by water carriers from the Ottawa River who sold water at $0.15 a barrel in summer and $0.25 in winter.

Thomas Keefer first submitted a plan of construction for a water works system on July 4, 1859, but it was not until March 6, 1872, that the City Council established the Board of Water Commissioners, who appointed Thomas Keefer as Chief Engineer.

Under his direction, the Fleet Street Pumping Station (still in use today) and a basic water distribution system, comprising some 31 miles of pipe and 3,665 service connections, were constructed and became operational in October, 1874.

On March 22, 1876, the Ottawa Daily Citizen reported on an inspection trip along the Capital's new $210,000 sewer by the City Fathers.

Reporters from three newspapers accompanied the City Engineer, Mr. Surtees, the Medical Officer, Dr. Lynn, contractors' representatives and several aldermen. The party left the (then) City Hall at Elgin and Albert and "after paddling through the snow across the canal" descended into the sewer by manhole. All carried lamps and the medical advisor had also thoughtfully brought brandy along to uplift the spirits of those affected by what the reporter termed "the strong effluvium" of the sewer. The party was cheered along the route by schoolboys (who also pelted the distinguished group with snowballs) and other spectators stationed at manholes. The men lit their pipes as a further defense against the "effluvium". At least two aldermen slipped and fell into a foot of cold water.

Although the newspaper noted that the sewer brickwork "had a remarkably fine appearance", a portion of the sewer arch before Cathcart Street had flattened out and the City engineer deemed it advisable that it be rebuilt. Near the Cathcart Street manhole, the party entered an all-stone sewer, "supposed to be the finest piece of sewer in America."

The Citizen included the following technical data:

> "The main sewer commences at a size of 6 feet 6 inches by 4 feet 4 inches at the outfall into the Ottawa River near the mills of Messrs. J. McLaren & Company, thence across Metcalfe, Redpath and Baird Streets (Metcalfe Square, that is) and Cathcart Square to station 2761, through rock cutting an average depth of about 20 feet, a distance of about 843 lineal yards. This portion is built entirely of stone.....the sewer then continues in stone along Cathcart Street to King Street in earth cutting. At this point, the brick, egg-shaped sewer commences, thence along King to Dalhousie, in earth cutting, to station 5900, a distance of 1146 lineal yards thence along George and Mosgrove Streets across Rideau Street to station 7450, a distance of 422 lineal yards, this portion being of the "horseshoe" pattern, with stone and brick arching. At this

> point the sewer is reduced to 4 feet 3 inches by 3 feet 4 inches (egg shaped) and continues along Mosgrove Street across the canal via Slater Street to Elgin Street, a distance of 582 lineal yards. Thence along Slater Street to Hugh (now Kent) in earth and rock.....900 lineal yards.....this sewer being egg-shaped, 3 feet 9 inches by 3 feet. The sewer then continues along Slater Street to Sally (now Lyon) a distance of 210 lineal yards. The cost of the sewer will be $210,000. The necessary eyes and connections are left in the sewer for entering the private and subsidiary drainage to be built later."

Subsequent issues of the Citizen reported that the sewer was extended into the Ottawa River below low water level. Two million bricks were used in the construction.

While the Citizen report did not give any health data, it is highly likely that the unsanitary conditions of that era resulted in high levels of contagious diseases.

The curtailment of infectious disease was an integral part of early urban development. When contagious disease reached epidemic proportions --as it frequently did-- public attention focused on the urban conditions that fostered disease and pressure for better public health measures mounted. But the outbreak of an epidemic also precipitated efforts, in some circles, to minimize the underlying causes and to resist demands for a greater expenditure on public health.

The incidence of typhoid fever in Ottawa was high throughout the first decade of the century. Ordinarily, however, the disease was primarily confined to the lower-class districts and civic officials showed almost no concern about the prevalence of the disease. Suddenly in January, 1911, the disease swept across the City. Each week, the number of reported cases increased. By early February, there were 119 new cases in one week alone. When the epidemic finally ended in late March, a total of 987 cases had been reported and 83 people had died from the disease. Despite this dramatic warning, civic authorities did little to remedy the underlying causes of the epidemic. In July, 1912, the City was stricken with a second and even worse typhoid epidemic; 1,878 people contracted the disease and 91 died from it.

The typhoid epidemic of 1911 prompted two investigations into its causes, both of which demonstrated that public health had been no more than a secondary concern for Ottawa's civic officials.

The causes of the typhoid epidemic were first investigated by the Chief Health Officer in Ontario, Dr. J. W. McCullough, in February 1911. Dr. McCullough concluded that contaminated water had been admitted into the City's water supply through an emergency valve located in Nepean Bay. While the City ordinarily took its water supply from the middle of the Ottawa River, the emergency valve in Nepean Bay was used often during the low-water period --- December to January --- to increase the water pressure in case of fire. The pollution in Nepean Bay was traced to Cave Creek, a small stream that ran through Hintonburg, a newly annexed portion of the City. This thickly-populated district did not have a full sewerage system and a large number of outdoor closets emptied directly into Cave Creek, which in turn, emptied into Nepean Bay. Since the City's water supply was untreated, there was no

protection from the contamination of the water supply by water-borne bacilli such as typhoid.

Having assessed the situation, Dr. McCullough did not hesitate to place the blame for the typhoid epidemic on the civic authorities. In his opinion, the civic authorities were guilty of failing to implement well-known and often recommended measures to ensure a safe water supply, yet, even before the turn of the century, the possible contamination of the City's water supply had been recognized as a problem. In 1900, the Medical Health Officer had pointed out that the increase in typhoid over the past year could be attributed to the fact that "the water supply was not what it should be." But despite the realization that the water supply was contributing to the incidence of contagious disease, the first serious consideration of improvements in the water supply did not come until 1910 when City Council decided to call in the well-known water works engineer, Allan Hazen of New York. Hazen was initially contracted to evaluate the Ottawa River as a water supply and to determine how it might be improved. He concluded that the best way to improve the quality of the water was to pass it through mechanical filtration after a preliminary chemical treatment.

Consideration of the means of improving the water supply grew more complicated when the City's waterworks committee asked Hazen to investigate an alternative source of water, McGregor Lake in the Gatineau Hills. He concluded that the McGregor Lake scheme, while more expensive than a mechanical filtration plant, offered a better supply of water than the Ottawa River. Finally, he recommended that hypochlorite of lime be added to the water supply as a temporary and partial treatment measure until either a mechanical filtration plant or the McGregor Lake scheme could be put into effect.

Hazen's advice was rejected by the Water Works Committee after a delegation consisting of John Grant (Chairman of the Committee and a member of the Board of Health), and the City Engineer and the City Treasurer went to Toronto to investigate the hypochlorite system in use there. On his return, Grant submitted a report that counselled against the use of hypochlorite of lime in Ottawa. His objections to the treatment were that the smell and taste of hypochlorite could not be overcome unless the chemical was introduced far away from the point of consumption, something that could not be done in Ottawa.

The typhoid outbreak was thus not the result of a single, if unfortunate, accident. Instead, it resulted largely from procrastination over the choice of a safe water supply and complacency about the health problem posed by the lack of one. A second investigation, ordered by Clifford Sifton of the Commission of Conservation, into the causes of the 1911 typhoid epidemic, concurred with the view that negligence on the part of the civic authorities with respect to the water supply was the chief factor in the outbreak of typhoid. The report, submitted by Dr. Charles A. Hodgetts, medical advisor to the Commission of Conservation, in April, 1911, criticized Ottawa's civic authorities for failing to take precautionary measures:

> "The outbreak could have been obviated had the hypochlorite treatment been installed forthwith after its recommendation by Mr. Hazen on October Fifth, 1910."

The investigation conducted by the Commission of Conservation uncovered a number of health problems besides the water supply. Unsanitary conditions existed in a large percentage of the City's dwellings; several sectors of the City had no sewage system, and the premises of milk vendors were only in fair condition at best. Roughly 357 of 14,000 houses inspected were deemed unfit for habitation; another 2,038 had outside privies; 1,107 yards were found to constitute a health hazard and 748 stables were found to be improperly constructed or kept.

A number of health measures --- all of which had at one time or another been recommended by the Medical Health Officer --- had either been neglected or partially implemented. Several sections of the City were still without a sewage system by 1911, making the enforcement of the by-law prohibiting privy vaults within certain limits of the City virtually impossible. The isolation hospital built in 1902, was often unable to accommodate all patients suffering from contagious diseases, and the smallpox hospital, situated on a flood-prone island, was in serious need of repair. Despite a high incidence of tuberculosis, the City did not have a tuberculosis sanitarium. And while the heavy rate of infant mortality during the summer months was largely attributed to the lack of means of preserving milk in many homes, civic authorities had not acted on the advice that a milk depot be set up.

If these appalling conditions could prevail in Canada's Capital, it is easy to imagine that even worse horrors were being inflicted on the public in other parts of the country.

On May 29, 1929, an explosion occurred in one of the main trunk sewer systems of the City of Ottawa and extended from Cartier Street near Frank Street to the outlet in the Ottawa River at the end of John Street, a total distance of 3-1/4 miles. The districts affected by the explosion were chiefly residential.

Mr. John Campbell, an American from Boston and explosives expert, was retained to report on this explosion. In his report he discussed the various possibilities such as gasoline, illuminating gas leaking from the gas mains, and sewer gas.

As a result of this report, ventilating stacks were installed on the sewer in three locations and it should be noted that these apparently prevented explosions in those sections of the sewer at a later date.

Among the recommendations made in the Campbell report was the appointment of a committee on hazards, functions of which were to be the consideration of the establishment of a central bureau to deal with all complaints, and the presentation to the Council of a series of by-laws for the regulation of hazards. This committee duly canvassed, considered, recognized and appreciated hazards incidental to the daily life of the municipality and presented its interim report on March 6, 1930. No action was taken by the civic authorities on the recommendations of this report and the activities of the committee apparently ceased. Meanwhile, and in general, conditions in some departments of municipal affairs had again relapsed into the old indifferent, haphazard methods of the past, with no attention to the intimation and expressed opinion contained in either the Campbell report or the interim report of the committee.

protection from the contamination of the water supply by water-borne bacilli such as typhoid.

Having assessed the situation, Dr. McCullough did not hesitate to place the blame for the typhoid epidemic on the civic authorities. In his opinion, the civic authorities were guilty of failing to implement well-known and often recommended measures to ensure a safe water supply, yet, even before the turn of the century, the possible contamination of the City's water supply had been recognized as a problem. In 1900, the Medical Health Officer had pointed out that the increase in typhoid over the past year could be attributed to the fact that "the water supply was not what it should be." But despite the realization that the water supply was contributing to the incidence of contagious disease, the first serious consideration of improvements in the water supply did not come until 1910 when City Council decided to call in the well-known water works engineer, Allan Hazen of New York. Hazen was initially contracted to evaluate the Ottawa River as a water supply and to determine how it might be improved. He concluded that the best way to improve the quality of the water was to pass it through mechanical filtration after a preliminary chemical treatment.

Consideration of the means of improving the water supply grew more complicated when the City's waterworks committee asked Hazen to investigate an alternative source of water, McGregor Lake in the Gatineau Hills. He concluded that the McGregor Lake scheme, while more expensive than a mechanical filtration plant, offered a better supply of water than the Ottawa River. Finally, he recommended that hypochlorite of lime be added to the water supply as a temporary and partial treatment measure until either a mechanical filtration plant or the McGregor Lake scheme could be put into effect.

Hazen's advice was rejected by the Water Works Committee after a delegation consisting of John Grant (Chairman of the Committee and a member of the Board of Health), and the City Engineer and the City Treasurer went to Toronto to investigate the hypochlorite system in use there. On his return, Grant submitted a report that counselled against the use of hypochlorite of lime in Ottawa. His objections to the treatment were that the smell and taste of hypochlorite could not be overcome unless the chemical was introduced far away from the point of consumption, something that could not be done in Ottawa.

The typhoid outbreak was thus not the result of a single, if unfortunate, accident. Instead, it resulted largely from procrastination over the choice of a safe water supply and complacency about the health problem posed by the lack of one. A second investigation, ordered by Clifford Sifton of the Commission of Conservation, into the causes of the 1911 typhoid epidemic, concurred with the view that negligence on the part of the civic authorities with respect to the water supply was the chief factor in the outbreak of typhoid. The report, submitted by Dr. Charles A. Hodgetts, medical advisor to the Commission of Conservation, in April, 1911, criticized Ottawa's civic authorities for failing to take precautionary measures:

> "The outbreak could have been obviated had the hypochlorite treatment been installed forthwith after its recommendation by Mr. Hazen on October Fifth, 1910."

The investigation conducted by the Commission of Conservation uncovered a number of health problems besides the water supply. Unsanitary conditions existed in a large percentage of the City's dwellings; several sectors of the City had no sewage system, and the premises of milk vendors were only in fair condition at best. Roughly 357 of 14,000 houses inspected were deemed unfit for habitation; another 2,038 had outside privies; 1,107 yards were found to constitute a health hazard and 748 stables were found to be improperly constructed or kept.

A number of health measures --- all of which had at one time or another been recommended by the Medical Health Officer --- had either been neglected or partially implemented. Several sections of the City were still without a sewage system by 1911, making the enforcement of the by-law prohibiting privy vaults within certain limits of the City virtually impossible. The isolation hospital built in 1902, was often unable to accommodate all patients suffering from contagious diseases, and the smallpox hospital, situated on a flood-prone island, was in serious need of repair. Despite a high incidence of tuberculosis, the City did not have a tuberculosis sanitarium. And while the heavy rate of infant mortality during the summer months was largely attributed to the lack of means of preserving milk in many homes, civic authorities had not acted on the advice that a milk depot be set up.

If these appalling conditions could prevail in Canada's Capital, it is easy to imagine that even worse horrors were being inflicted on the public in other parts of the country.

On May 29, 1929, an explosion occurred in one of the main trunk sewer systems of the City of Ottawa and extended from Cartier Street near Frank Street to the outlet in the Ottawa River at the end of John Street, a total distance of 3-1/4 miles. The districts affected by the explosion were chiefly residential.

Mr. John Campbell, an American from Boston and explosives expert, was retained to report on this explosion. In his report he discussed the various possibilities such as gasoline, illuminating gas leaking from the gas mains, and sewer gas.

As a result of this report, ventilating stacks were installed on the sewer in three locations and it should be noted that these apparently prevented explosions in those sections of the sewer at a later date.

Among the recommendations made in the Campbell report was the appointment of a committee on hazards, functions of which were to be the consideration of the establishment of a central bureau to deal with all complaints, and the presentation to the Council of a series of by-laws for the regulation of hazards. This committee duly canvassed, considered, recognized and appreciated hazards incidental to the daily life of the municipality and presented its interim report on March 6, 1930. No action was taken by the civic authorities on the recommendations of this report and the activities of the committee apparently ceased. Meanwhile, and in general, conditions in some departments of municipal affairs had again relapsed into the old indifferent, haphazard methods of the past, with no attention to the intimation and expressed opinion contained in either the Campbell report or the interim report of the committee.

About 4:50 p.m. on January 28, 1931, another explosion occurred within the same district in a manhole at the corner of Lewis and Robert Streets and which extended therefrom over the same system as that of the explosion of 1929, westerly to O'Connor Street and easterly to River Road, Eastview, a distance of approximately 2-1/2 miles. This later explosion was more severe and destructive than that of 1929 but did not extend so far into the district east of the Rideau River. The reason it did not, as mentioned earlier, was the installation of ventilating shafts in this area.

A large number of manhole covers were blown off along the line of the main outfall sewer on the west bank of the Rideau River commencing on Cartier Street, Lewis, Templeton, Nelson and Somerset Streets and on the east bank of the Rideau River to John Street. Other manhole covers were blown off on Waverley Street, east of Cartier Street and on the outfall sewer near the isolation hospital on the west bank of the Rideau River. It is of interest to note that in 1929, 28 manhole covers were blown off and in 1931, 28 manhole covers were also blown off, but only 16 of the same manhole covers were blown off in each explosion.

The main outfall sewer on the east bank of the Rideau River as far north as Cummings Bridge was so severely damaged that the top half of the brick sewer, 6 ft. 6 in. in diameter, had to be entirely rebuilt for a length of 2,000 feet. The same sewer on the west side of the Rideau River on Somerset and Nelson Streets was damaged along the crown of the sewer and had to be repaired over a length of 1200 feet. The 5 ft. diameter sewer, in the neighbourhood of the isolation hospital, had to be replaced by an entirely new sewer over a length of 1200 ft.

On February 9, 1931, the firm of Gore, Nasmith & Storrie was retained by the City of Ottawa "to make investigations of the sewers of the City of Ottawa for the purpose of determining the condition and sufficiency of them, whether they themselves might be the real or contributory cause of the explosions of January 28th and to report on these or any other conditions which your firm discovers in its investigations."

Several recommendations were made as a result of the consultant's report, including that the records of all establishments using inflammable gas or liquids be open to inspection by the City authorities. The consultant also recommended that the ventilation of the City sewers be changed and that a system be commenced whereby all main sewers would be thoroughly inspected every six months.

Many claims for damages and compensation were made against the City subsequent to both the explosions of 1929 and 1931. Many claims after the 1929 explosion were paid directly by the City; however, in 1933, the City of Ottawa took the Gas Company to court to seek to recover the very large sum of money expended by the City in repairing its sewer system after these explosions. It was alleged that the explosion was caused by an accumulation of illuminating gas in the sewer system which the Ottawa Gas Company had either negligently or otherwise permitted to escape from its mains and which had found its way into the sewer or into pockets adjacent thereto.

After a long summation by the Judge, he declared that the action fail and must be dismissed with costs.

In 1944, a Joint Committee of the Senate and House of Commons was appointed to review and report on the relationship between the Federal Government and the City of Ottawa. During its fifth and sixth sessions on July 19 and 20, the committee discussed the matter of disposing of raw sewage in the Ottawa River and the need for a suitable sewage disposal plant. In their final report of August 1, 1944, the Joint Committee, in addition to several other recommendations, made the following recommendation with regard to sewage disposal for the capital City:

> "That a great need exists for an improved modern system of sewage and garbage disposal, both from the point of view of the interest of the municipality and the Federal Government. Very little attention has been given to this subject which, in the light of possible future developments, will require joint action on the part of the government and the City in the planning and financing of that project."

In 1946, a Committee known as the National Capital Planning Committee was appointed to draw up a master plan of the National Capital District and to advise the Commission of the gradual and subsequent development over a term of years. At the inaugural meeting of the National Capital Planning Committee in October 1946, the subject of the pollution of the Ottawa River was discussed.

Subsequently, in 1947, the National Capital Planning Committee asked Ottawa, Ontario, and Aylmer, Deschenes, Hull, Gatineau Point, and Gatineau, Quebec, to make studies to the end that necessary sites for sewage disposal plants might be selected as an assistance in the preparation of the plan for the National Capital District.

In compliance with this request, in 1948, City Council approved the recommendation of the Ottawa Planning Area Board that a firm of independent consultants be retained to make investigations and report on the future extension of water and sewer services within the Ottawa area. The firm of Gore & Storrie was retained to perform this survey, with the cost shared one-third by the Federal District Commission, one-third by the City of Ottawa, and the remaining one-third equally by the Township of Gloucester, the Township of Nepean, Eastview and the Village of Rockcliffe Park.

In July, 1949, the report on water supply and sewage disposal for the City of Ottawa and related areas was completed by Gore & Storrie. Briefly summarized, the consultants called for:

> Unified control over all water supply and sewage disposal for the City of Ottawa and urban areas;
>
> The existing waterworks system owned by the City of Ottawa on Lemieux Island should be the source of supply for the whole area;
>
> All sanitary sewage and industrial wastes should be prohibited from the Ottawa River upstream from the Chaudiere Dam, and as far as practicable, from the Rideau River;
>
> The separate system of sewers should be adopted in all new and undeveloped areas.

In 1951, the City of Ottawa expropriated 320 acres in the Green Creek area for the purpose of developing a sewage treatment plant. Ottawa was the only municipality in the National Capital Area to acquire such a site. The Federal District Commission assisted the City financially in the acquisition, by agreeing to assume the carrying charges in the debenture issue for a 12 year period. Assuming that the site would cost $200,000.00, the total contribution of the Federal District Commission for the site would be approximately $98,400.00.

The Gore & Storrie report was adopted by the City of Ottawa and its provisions have governed the construction of all sanitary and storm sewers within the City since parts of the Townships of Gloucester and Nepean were annexed to the City on January 1, 1950.

The Gore & Storrie scheme embodied the construction of three main collector sewers, West Nepean, South Nepean and the Rideau River collectors, which, together with the system of existing and future trunk sewers, delivered sewage by gravity flow to a number of points on the south side of the Ottawa River between Nepean Bay and Rockcliffe Airport.

In 1951, the City, with the assistance of the Federal District Commission, commenced construction of the various collectors, all being a major component of the overall sewage disposal plan.

The Federal contribution was based on the Sellar "Advance of Need Formula" and the actual amount contributed was approximately $1,678,000.

In January, 1958, the City retained a consulting engineering firm, James F. MacLaren Ltd. (Mr. MacLaren was a co-signator of the 1949 Gore & Storrie Report) to carry out more detailed investigations to determine the design and estimated cost with respect to the proposed sewage treatment plant.

Similarly, the City retained the firm of DeLeuw Cather Company of Canada to report on the Ottawa River interceptor and outfall sewers.

The overall plan as contained in the reports of James F. MacLaren Ltd. and DeLeuw Cather Company of Canada provided for the construction of an interceptor sewer from the existing end of the West Nepean Collector, in the vicinity of Booth Street, along the Ottawa River to John Street, and an outfall sewer from this point to the Green Creek site of the sewage disposal plant.

At this time, raw sewage was being discharged into the Ottawa River from nine locations within the limits of the City of Ottawa, two locations from the Village of Rockcliffe outlet and twelve connections direct from Federal establishments. These various outlets to the Ottawa River ranged in size from 9 in. up to 84 in. in diameter.

The proposed interceptor and outfall sewer would intercept all of the nine City of Ottawa municipal outlets which now emptied into the Ottawa River, plus the two outlets from the Village of Rockcliffe and the twelve outlets from the Federal establishments located along the Ottawa River. The sewerage scheme at this time comprised a gross area of 61.8 square miles which included all of the City of Ottawa, the Town of Eastview, the Village of Rockcliffe, parts of the Township of Nepean and parts of the Township of Gloucester.

It was estimated at that time that an average of 25,000,000 gallons of raw sewage was discharged into the Ottawa River each day. This amounted to a discharge of about 4,500,000,000 gallons of raw sewage into the river during the six summer months of May to October when the pollution was most objectionable. The recommended scheme would reduce the volume of sewage discharged in the rivers at the City front in the summer from 4,500,000,000 gallons to approximately 78,000,000 gallons, or a reduction of some 98 percent.

In the older part of the City, there was a combined sewerage system where the same sewer took both sanitary and storm flow. The proposed scheme of interceptors was designed to carry 2-1/2 times the expected dry weather flow, thus 2-1/2 times the normal sanitary flow. During the periods of severe storm runoff, the storm flow, over and above 2-1/2 times the dry weather flow from the combined sewer system, would discharge directly into the Ottawa River. This would account for the remaining two per cent of the estimated 78,000,000 gallons.

The report stated: "The interceptor sewer will run from the vicinity of Booth Street to the vicinity of John Street and have a total length of 12,930 feet and consist of 72 in. and 84 in. circular pipe. The outfall sewer from John Street to Green Creek will be 25,360 feet in length and of 96 in. circular pipe. Due to the length of the sewers and the necessity for establishing satisfactory grades on these sewers, it will be necessary to construct them at considerable depth from the present ground surface. The sewer must be deep enough at the extreme westerly end to intercept the sewage from the West Nepean collector at Booth Street. This necessitates a depth of 56'feet from the ground surface at this point. To maintain the gradient necessary to provide satisfactory flow, it will require a drop of approximately 36 feet in the length of the sewer." This meant tunnelling at considerable depth beneath the heart of the City. At the Parliament Buildings, the sewer tunnel is 122 feet deep, at Rockcliffe, 185 feet, and at the treatment plant, 63 feet.

Although the estimated flow from the City was 25,000,000 gallons, the sewer was constructed to serve the ultimate volume for the area, estimated to be 58,000,000 gallons per day. Thus, while the scheme proposed for the City was sufficient in size to accommodate the ultimate output of the drainage area from the West Nepean, South Nepean and Rideau River collectors estimated at 58,000,000 gallons daily, only 64.2% of the total area to be served lay within the confines of the City of Ottawa proper.

It was proposed to build the sewage disposal plant itself to handle in the first instance 40,000,000 gallons, even though the estimated flow at that time was 25,000,000 gallons per day. The initial plan of the sewage plant was laid out for an ultimate capacity of 75,000,000 gallons per day, thereby serving an estimated eventual population of 590,000 persons. Of this 75,000,000 gallons per day, 58,000,000 gallons would come from the Ottawa River outfall sewer presently contemplated. A further 17,000,000 gallons was to come from the future Green Creek collector which would serve the south-easterly part of the City and the Township of Gloucester but this was not included in the scheme at that time.

It was recommended by James F. MacLaren Ltd. that the sewage treatment plant be completed in two phases, the first being the construction of a primary treatment phase including sedimentation and disinfection, and a

later phase including secondary or biological treatment. The first phase of the work included the construction of the interceptor and outfall sewer, plus the primary treatment plant and sludge lagoons, etc., at a total estimate of $20,650,000.

Late in 1960, the Federal Government enacted legislation which provided for financial assistance to municipalities in the construction of major sewage projects. This legislation provided that the Central Mortgage and Housing Corporation would make loans to municipalities of two-thirds the cost of approved sewage projects and, if these projects were completed before April 1, 1963, 25% of the loan and of the interest on the loan advances during the course of construction would be cancelled. On January 16, 1961, City Council approved of an accelerated program for the construction of the Ottawa Pollution Control Centre which would enable it to be completed by April 1, 1963.

Tenders for the plant were called in the spring of 1961 and the first two contracts, one for the main building and related structures and one for the four raw sewage pumps, were awarded to J. A. Jones Construction Company Canada Limited and Worthington Canada Limited, respectively, on March 27, 1961.

Tenders for Contract #3, the elevated water tank, and Contract #4, the Primary and Digestion Tanks and related structures, were called shortly after, with the award of Contract #3 being made to Bridge and Tank Company of Canada Limited and the award of Contract #4 being made to J. A. Jones Construction Company Canada Limited on June 5, 1961.

The interceptor and outfall sewer was completed in 1962 and the 40 MIGD Green Creek Pollution Control Centre was also completed in that year.

At the corner stone laying, on November 15, 1962, the following were placed in a copper records box behind the corner stone at the City of Ottawa Pollution Control Centre:

"The Ottawa Citizen" for November 15, 1962.
"The Ottawa Journal" for November 15, 1962.
"LeDroit" for November 15, 1962.
List of Members of City Council and Civic Officials.
Copy of City Council Minutes, January 8, 1959, authorizing the following:

1) Primary Treatment only to be developed as First Stage.
2) Plant to be Constructed over 6 Year Period starting 1959.
3) City to proceed with its own arrangements to construct and operate the plant.
4) The consultants to prepare final plans.

Copy of City Council Minutes, January 16, 1961, outlining revised staging and speeded-up program as a result of Federal Government aid announcement.
Copy of City Council Minutes, March 27, 1961, awarding Contract #1 to J. A. Jones Construction Company (Canada) Limited.
Copy of City Council Minutes, June 5, 1961, awarding Contract #4 to J. A. Jones Construction Company (Canada) Limited.
Booklet "Ottawa, Canada's National Capital".

Booklets - French and English Copies "The Armorial Bearings of the City of Ottawa".
Invitation List to Ceremony.
Set of Newly Minted Coins dated 1962, 1 cent, 5 cents, 10 cents, 25 cents, 50 cents and one dollar.

The official opening of the plant took place on June 27, 1963, on a very warm summer day.

Following the official program, a tour was given of the new plant and was followed by a reception in the ballroom of the Chateau Laurier. It should be noted that the sod turning ceremony for the Green Creek Plant took place on June 14, 1961, almost two years prior to the official opening of the plant.

In 1960, in the City of Ottawa there were 318 miles of sanitary sewers, 200 miles of storm sewers and 204 miles of combined sewers. The combined sewers were found within the limits of the City of Ottawa prior to annexation. Since the Gore & Storrie Report of 1949, and since the annexation in 1950, the separate system of sewer construction has been adopted by the City of Ottawa.

It had been apparent for some time that a problem of inadequate sewer capacity existed in the old combined sewers in the downtown sections of Ottawa. Added to this, the recent trend in the downtown area toward high-rise apartment blocks and commercial buildings had tended to aggravate what was already considered a serious problem.

One day, while Controller Lloyd Francis of the Ottawa Board of Control was discussing the high cost of replacing inadequate downtown sewers with W. L. Keay, the Engineer in charge, the remark was passed that it was too bad there were no means of charging the high-rise buildings which were causing the problem. From this came the idea that a special charge should be looked into from the legal viewpoint. This charge was popularly known as the High-Rise Charge.

Because of the concern of City Council over the continued erection of these new multiple-dwelling buildings and commercial structures which impose a heavy load on the sewer system, it was decided that a redevelopment fund should be established for the construction of sanitary and storm sewers which might have to be built. This fund was created by making a levy on each new dwelling unit, or equivalent space in the case of a commercial building, to be paid on the issuance of a building permit.

In order to give effect to this resolution, the City of Ottawa applied to the Provincial Legislature for special legislation. This special legislation was granted under Section 4 of the City of Ottawa Act, 1960-61 (Statutes of Ontario 1960-61, Chapter 120) which authorized the Council of the Corporation of the City of Ottawa, subject to the approval of the Ontario Municipal Board, to pass by-laws for imposing upon the owners of high-rise or other buildings, for the erection or enlargement of which a building permit was issued subsequent to May 2, 1960, a special charge to provide for additional sanitary or storm sewer or water supply capacity.

Initially, the City enacted a by-law which provided for a charge of $150.00 for each dwelling unit in excess of two units, in respect of new

residential buildings, and a charge of 20 cents per square foot of gross floor area in excess of 1,500 square feet, in respect of non-residential buildings. This by-law, as specified in the Act, required the approval of the Ontario Municipal Board and after a public hearing the Board ordered that it would approve of a by-law providing the aforementioned charges were reduced to $125.00 per dwelling unit and 17 cents per square foot of floor space respectively.

As a result of the order of the Ontario Municipal Board, the City then passed By-law No. 449-62 which reduced the charges enumerated to $125.00 for each dwelling unit and 17 cents per square foot of floor space for non-residential buildings.

This By-law was appealed by the owners of certain buildings through the Lower Courts which upheld the By-law, and then to the Supreme Court of Ontario which ruled the By-law ultra vires of the enabling legislation. The City then appealed the decision of the Supreme Court of Ontario to the Supreme Court of Canada which upheld the By-law.

During the period while legal proceedings were taking place on the redevelopment charges, the Sewerage and Drainage Branch began studies on the downtown Central Core area, where serious flooding had occurred. When approval was finally received for the collection of these charges, City Council hired two consulting engineering firms to report on the separation of the combined system to the east and west of the Central Area known as Area 1. Laughlin, Wyllie and Ufnal, and James F. MacLaren Limited were retained to report on Areas 2 and 3 respectively to the east and west of the Central Area. The reports on these three areas were submitted to City Council and formed the basis for future sewer construction in these sections of Ottawa. The three areas cover approximately one-half the total combined sewer area of Ottawa and were selected because they comprise sections in which redevelopment was imminent, assessment was high, and serious flooding problems existed.

Before attempting to analyze the existing system for hydraulic adequacy, it was decided that the physical condition of the existing manholes and pipes should be ascertained to evaluate their further useful life. The first step in this program was a visual inspection which revealed that many of the older sewers were poorly aligned, resulting in open joints and infiltration and, in some cases, cracks could be observed in the pipes, indicating structural failure.

Sewers under 24" in diameter, which could not be inspected visually, represented by far the greater footage of sewers in the area. Due to the fact that photographic inspection was time-consuming and expensive, it was decided that representative sewers would be photographed and the results applied to sewers of similar size and age. As in the case of the visual inspection, poor alignment, cracks and open joints were observed. Some lines were infested with tree roots and evidence of pipe settlement was quite common.

After the visual and photographic inspection was completed, a hydraulic study was then carried out on those sewers which appeared to be in good physical condition.

In the analysis of the combined sewers to serve as future storm sewers, it was found that, except in the case of a few large trunk sewers, the sewers had insufficient capacity to handle the estimated storm runoff.

Since 1949, the City of Ottawa had maintained manhole surcharge gauges in strategic locations throughout the combined sewer area. These gauges had been increased in number throughout the years until there were now approximately 120 of them located throughout the City. After each major rainstorm, the level to which water rose in the manhole was recorded. This information proved invaluable in the study of hydraulics of the existing system. In addition to this, the property owner complaint records, showing basement floodings, were plotted on a plan which gave an accurate picture, along with the gauges where relief of the system was required.

In view of the fact that an additional sewer would be required to handle the existing and future flows from each street, it provided an excellent opportunity to separate the system, with the new sewer handling all storm flows and the existing combined sewer continuing, where possible, to carry the sanitary flows. In certain areas, because of the age and condition of the existing sewers, it was necessary to install both storm and sanitary lines. The structural defects in the existing pipes precluded the construction of storm sewers only in many streets, because excavation work, especially in rock areas, might have resulted in damage or collapse of existing sewers.

Events during the latter part of the 60's and the early 70's placed renewed emphasis on the City's sewer system. These events were:

1. Widespread basement flooding resulting from unusually heavy rainstorms.

2. Beach closures by the Medical Officer of Health resulting from high bacterial counts in the Rideau and Ottawa Rivers.

3. Expanding development within, and in areas adjoining, the city.

The widespread basement flooding prompted a search for short-and long-term measures by the, then, City Engineer, Tom Dobbin, and his staff.

The short-term measures included overflow relief and emergency pumping schemes, and an assessment of how property owners might protect themselves. In the latter case, a protective plumbing bulletin was produced for the guidance of property owners.

The long-term measures were identified initially through a fresh in-house study of the sewer system undertaken during the latter part of 1970. This study was undertaken primarily to establish the outstanding sewer works necessary to completely service the City to currently accepted standards and to place them in some order of priority. In effect, this was an update and extension of the Areas 1, 2 and 3 Sewer Separation Reports of 1965.

The study identified the length of existing City-controlled sewers as 762 miles and the additional length required to service the ultimate development of the city as 610 miles. This would be made up of 257 miles of sanitary sewer and 353 miles of storm sewer. The estimated cost at that time of this outstanding work was 142.4 million dollars, including 69.0 million dollars to complete separation of sewers in the

Combined Sewer Area. Priorities were identified and a program extending over 25 to 35 years was recommended.

In October, 1971, Gore & Storrie Limited and Proctor & Redfern Limited were jointly appointed to prepare a sewer policy report and a master plan of sewerage for the City, to be based in large measure on Mr. Dobbin's in-house report of the previous year. The consultants' report was submitted in May, 1973, and provided a permanent record of the development of the sewerage system to date, a drainage policy to adopt for future works, a generalized master plan, and more detailed proposals for two selected areas - Urbandale/Elmvale and the Glebe Area.

The combination of the in-house report and the consultants' report provided the main impetus for sewer planning. Emphasis was placed on the construction of major storm outlets, involving extensive tunnelling work and heavy commitments on the capital budget. However, they were an essential 'first step' to an adequate storm drainage program, the implementation of which has continued throughout the subsequent years. It is believed that the City now enjoys one of the highest levels of protection to be found across the Province.

In the summer of 1971, several of the City's bathing beaches on the Rideau River (there are five beaches in all, and a further three on the Ottawa River) were declared by the Medical Officer of Health, Dr. L. H. Douglas, to be unsafe for bathing.

This followed a series of bacterial water quality surveys undertaken by the Ottawa-Carleton Regional Area Health Unit. Subsequent to the Rideau River beach closures, beaches on the Ottawa River were also closed.

These closures sparked a great deal of controversy over the interpretation to be placed on the Ministry of the Environment's guidelines for acceptability of waters for "body-contact recreation" and the manner in which they were intended to be applied. While it was recognized that the quality of the river water had improved considerably over the years as sanitary drainage facilities had advanced, water quality monitoring in the past had been more from the aesthetic than the bacteriological aspect. The City of Ottawa was 'trail blazing', in effect, and since that time other municipalities have followed suit with much more stringent bacterial monitoring of their beach waters. In some cases, this has resulted in beach closures elsewhere for at least part of the season.

Many innovative approaches were considered to keep at least some of the Ottawa beaches open. These ranged from 'beach containment', whereby the beach environment would be retained, but the swimming waters would be chlorinated, to 'beach flushing' whereby better quality water drawn from midstream would be directed along the beach area to remove what was considered to be essentially bather-induced contamination.

The 'beach containment' approach proved unacceptable since the facility would then become subject to the Ministry of Health's swimming pool regulations. These required not only a much higher clarity of water than that of the natural river water but also extensive and sophisticated features such as concrete paving of the river bed, showers, foot baths, changing facilities, fencing, and so on.

The 'beach flushing' approach was applicable, and proved successful in the case of the City's largest and most popular beach at Mooney's Bay where high delivery/low head pumps were installed. The Hydraulics Laboratory of the National Research Council had undertaken a model analysis to establish the size of pumps required and the method of delivery needed to ensure bather comfort while still providing an effective flushing action.

A major report on Pollution Investigation and Abatement, issued by the Regional Works Department in September, 1972, concluded:

> "It has become obvious that a major source of pollution to the Rideau River and from the Ontario side of the Ottawa River is simple land wash, caused by heavy or continuing rainfall.
>
> ... We have established that runoff from roofs, streets and fields contributes contaminants to surface waters in our urban areas."

Attempts, on this account, to introduce chlorination facilities at Mooney's Bay for use following heavy rainfall, i.e. when bacterial counts were naturally high due to land wash from non-urban areas of the catchment, were vehemently opposed by public interest groups who feared adverse effects on fish life. This was notwithstanding that continuous chlorination of sewage effluent was common practice throughout the Province.

Other short-term measures taken at that time included ponding of runoff on a major tributary stream to effect some improvement in runoff water quality, a review of street sweeping practices to reduce contamination from street runoff, and a 'search and destroy' operation directed to illegal connections of sanitary building sewers to storm sewers. This latter program was referred to as the Pollution Abatement Program and extended over several years. Many thousands of connections to the sanitary system had to be dye-tested and, for this purpose, the City was divided into 37 areas. It involved a crew of five men and, by way of example, in the year 1973, 3,380 premises were checked and 388,000 feet of sewer were examined. The number of improperly connected building sewers located was two. However, the total number of cross connections located throughout the program was in excess of 100.

Because of the involvement of many authorities in pollution not only of the Rideau River but of the Ottawa River (which is interprovincial), the, then, Commissioner of the Regional Works Department, Frank Ayers and his Director of Pollution Control, Bill Keay, together with the City Engineer, Tom Dobbin, engineered the establishment of a multi-representative technical group to provide ongoing monitoring of pollution abatement activities affecting the lower Rideau River. This group became known as TPAC (Technical Pollution Abatement Committee) and included representation not only from the Region and area municipalities, but also from the Federal and Provincial Governments.

Both the Regional Works Department and the Regional Health Unit continued to monitor the beach areas independently for total coliform, fecal coliform and fecal streptococci; in addition, the Regional Works Department monitored storm sewer systems to narrow down potential contamination sources and reported its findings to the appropriate area

municipality. The area municipality would then carry out more detailed investigations; once the polluting source, or sources, had been identified, it would take the necessary corrective action and report back to TPAC.

TPAC has continued to meet on a regular basis over the years and has been instrumental in the commissioning of several studies as the complexity of the problem and 'state-of-the-art' limitations have become more and more apparent.

One of the earlier studies was that entrusted to Dr. Mike Dickman, a professor at Ottawa University. Dr. Dickman, together with many of his university colleagues, and with some input from the various agencies involved (who comprised a committee known as the Rideau River Pollution Abatement Technical Committee) undertook the study over an eight-month period in 1974. The study concerned itself not only with bacterial contamination (in the form of fecal coliform), but also with oxygenation and eutrophication aspects of the river. In brief, the study concluded that, while the River was generally well oxygenated and was only marginally contaminated with fecal coliform, it was nutrient-rich and, therefore, supported dense algae and waterweed growth in its lower flowing sections. In addition to endorsing the various measures taken by the Region, the City, and other agencies, the study report contained a number of recommendations for advancing the 'state-of-the-art'.

Dr. Dickman's 1974 report was followed by a demonstration grant proposal covering the reduction of pathogens in storm water, and the reduction of excessive weed and algae growth.

Although its recommendations were not pursued in depth, this document did lead to other studies being undertaken. They were of expanding scope and culminated in the Provincially-sponsored Rideau River Study.

At the end of 1973, the Ministry of the Environment informed all area municipalities that, in view of the continuation of contamination caused by urban storm drainage, any new development must be based on the principle of no deterioration to the existing quality of local watercourses. Treatment would be necessary for storm drainage from new subdivisions but this was taken to apply only to subdivisions in the Rideau River drainage area.

A 'state-of-the-art' for storm water treatment was virtually non-existent and there was no Ministry policy in this regard. It was agreed that the first two or three new developments within the Rideau drainage area would include storm water detention facilities. These facilities would be regarded as experimental and would allow for testing on the effects of storage and such things as chlorine and alum treatment.

The concentration of effort and money into watercourse improvement in Ottawa has developed a new awareness of health risks associated with beaches and led to innovative methods of maintaining or improving water quality. The benefits of this experience are being felt not only in Ottawa but elsewhere across the Province.

CHAPTER SIX

THE OWRC/MOE SAGA

One night in 1953, Governor General Vincent Massey invited Ontario Premier, Leslie Frost and his wife to a small, informal dinner at Government House in honour of U.S. President Eisenhower.

A chance remark at this small gathering was to profoundly affect water resource management in Ontario. The evening was recounted in a Toronto Star series "The Tory Years", written by Jack Cahill.

Premier Frost recalled it was also Mrs. Eisenhower's birthday and the small group sang "Happy Birthday Mamie".

President Eisenhower took the Premier by the shoulder and told him:

> "You really should remember this, that really pure water is one of your greatest assets. But when you've got a lot of it, you don't think about it. We have ruined ours in the States with our growth of population so that the great beautiful rivers that flow into the Atlantic and down through the Mississippi Valley and so on are contaminated. You have a great country with great possibilities so don't let them ruin your water."

Mr. Cahill wrote: "When he went home that night Frost conceived the idea of the Ontario Water Resources Commission (OWRC)." However, such an organization had also long been the dream of Dr. Albert Berry who had already been working tirelessly behind the scenes to improve public health and environmental facilities.

Mr. Frost was to give a young back-bencher from London, named John Robarts, some responsibilities for the proposed OWRC, partly because London was suffering a water shortage but also because he wanted to see how Robarts would act in a position of authority. The concept also affected the political destiny of Mr. Robarts who later became Minister of Education in the Ontario Government under Mr. Frost, eventually succeeding him as Premier. Some arduous planning and administrative work had to take place before the OWRC dream became a reality. In April 1955, a memorandum was prepared following a survey of Ontario water resources, sponsored by the Ontario Department of Health under a Federal Government health grant. It stated that the most critical water supply situation in Ontario was in the southwestern section inland from the Great Lakes and suggested water resources planning should be made well in advance of actual needs. Further, Ontario legislation needed clarification to ensure proper control over conservation, distribution, allocation and rights to water supplies for various uses in all sections of the Province. Pollution of streams should be reduced to a minimum to permit best uses of these waters.

The memo said that methods should be determined for developing, financing and managing water supply projects to serve an area rather than one municipality. It advocated "the formation of some provincial body with jurisdiction over all water resources", the function of which "would be to ensure the conservation and distribution of water to all parts of the Province, and the allocation of quantities to different

users." There was need for continuous study and supervision of Ontario's water resources.

A short time later, the Water Resources Committee of Southwestern Ontario published a brief it had prepared on the Development and Control of Water Resources. This Committee had been set up following a meeting called by the Waterloo Chamber of Commerce on February 19, 1954, of representatives of municipalities in that southwestern area.

This brief, recognizing that Ontario had led the way in the management and control of its power resources by the creation of the Hydro Electric Power Commission of Ontario, said "there is no doubt that control and management of the water resources will be, in due time, a greater factor in the growth and productivity of a great and important part of the Province."

Interestingly, the brief was signed by A. M. Snider of Waterloo, who later became chairman of a government appointed Water Resources and Supply Committee, and later the first Chairman of the Ontario Water Resources Commission on May 3, 1956.

The environmental situation in southwestern Ontario at the time was summed up by Professor W. M. Walkinshaw, of the University of Toronto's Department of Civil Engineering, in an address before the 69th annual meeting of the Engineering Institute of Canada, in Toronto in May, 1955. He concluded there was a critical ground water supply situation in the region, with problems existing in regard to both the quantity and quality of the water. He added that many important cities whose welfare was a matter of vital concern to Ontario were dependent upon supplies, which at best were uncertain. The main cities causing concern were London, Kitchener and Waterloo, with Aylmer, Dresden, Stratford and Leamington also mentioned.

A Water Resources and Supply Committee was planned but a provincial election temporarily held up appointment of other members of the new committee. In July, 1955, Mr. Frost, whose government had been returned to office, announced the Committee would comprise:

Mr. A. M. Snider	- Chairman
Dr. C. H. Reason	- surgeon and chairman of the London Public Utilities Commission
B. L. Bedford	- Chatham lawyer and former mayor of that city
W. D. Conklin, Q.C.	- Kingsville lawyer and businessman
J. A. Vance	- Woodstock contractor and past president of the Engineering Institute of Canada

Advisors to the committee were announced as:

J. A. Millar	- Ontario's Deputy Minister of Public Works, Engineering Division
Dr. A. E. Berry	- Director, Division of Sanitary Engineering, Ontario Department of Health

he committee held its first meeting, an organizational gathering in oronto, August 10, 1955, following a conference with Mr. Frost. ollowing the meeting, Mr. Snider announced -- "We are started now and ace a tremendous task. Our terms of reference are broad and we have uch information to gather. We will get this information by meeting ften and by holding public meetings in various municipalities to letermine local problems."

During a break in the first meeting of the Committee on August 10, 1955, members visited Mr. Frost. The Premier said their task was of great importance -- they were engaged in a vital public service and the success of their efforts would depend on co-operation between municipalities, industry, agriculture and the Provincial Government.

He also stressed that plans developed by the Committee must be financially self-liquidating (this was made clear at subsequent public hearings held by the Committee -- indicating, particularly to municipalities, that Provincial Government assistance in the obtaining of required services would not include direct financial aid).

The Premier emphasized the importance of pollution abatement in the Committee's considerations, as much of the Committee's energies had focused on obtaining water supplies.

The committee recognized that Ontario had international responsibilities under the International Joint Commission agreements.

At a meeting on November 15, 1955, consideration was given to the provision of sewerage systems in conjunction with water supply systems. Dr. Berry remarked that the cost of a sewage treatment system might be so high that the possibility of a waterworks system might not be favored by many municipalities. However, he said, the two could not be disassociated. He suggested it would be the responsibility of the Committee to make sure that adequate sewerage facilities were installed by municipalities obtaining new water supplies.

Mr. C. G. R. Armstrong, a Windsor Consulting Engineer, was commissioned to make a survey and submit an estimate of cost of a preliminary plan for a water system "that will adequately take care of the water requirements of the towns of Essex and Harrow." The plan was to provide for estimated future expansion for the next 10 to 25 years.

His responsibilities included a thorough investigation of Lake Erie to determine the most suitable locations for the necessary intake lines; while a report was to be made, also, of the water requirements of that portion of the county not presently being served by Windsor.

With this consulting assignment, the Committee had instigated what was to become an enormous program which was ultimately taken over by the Ontario Water Resources Commission and extended to other regions. During the same meeting, Chairman Snider reported on a visit he paid to General A.G.L. McNaughton, Chairman of the Canadian Section of the International Joint Commission. General McNaughton had indicated there should be no difficulty in obtaining permission from the IJC for plans to utilize, for domestic and industrial use, water from one Great Lake and discharge it into another, provided the discharge took place above Niagara Falls. The Canadian IJC chief also had mentioned six Ontario locations where pollution was causing international difficulty -- Sault

Ste. Marie, Sarnia, Windsor, Fighting Island (six miles below Windsor and 14 miles up the Detroit River from its mouth), Amherstburg and Fort Erie.

But the Committee found serious problems at the local level also. In a personal report to Premier Frost, Mr. Snider wrote that in Essex County:

> "We were almost astounded at some of the information given us -- villages and rural areas with no local water fit to use, tank trucks hauling water from the lakes to inland areas, with streams and drainage ditches badly polluted."

Mr. Snider went on to report that at a subsequent hearing in Chatham, covering Kent and Lambton counties, it was found the situation of the inland areas in these counties,

> "is similar in many respects to those of Essex -- well water with salt and sulphur, rivers and streams badly polluted, tank trucks serving districts with poor water."

But international problems persisted also. During the 1954-1956 period, correspondence between Mr. Frost and Prime Minister Louis St. Laurent had discussed pollution of boundary waters in the connecting channels of the Great Lakes. In a letter from Ottawa, dated November 16, 1954, Mr. St. Laurent reminded Mr. Frost of a 1950 report of the International Joint Commission which stated that these waters "are being polluted on either side of the boundary to the injury of health and property on the other side of the boundary." This indicated that the pollution was in excess of that which Canada and the United States agreed to prevent when they ratified Article IV of the Boundary Waters Treaty of 1909. The IJC report resulted from a joint 1946 reference to the Commission by the Canadian and Ontario governments of the subject of pollution of these specific waters.

The Canadian Prime Minister reiterated that "both countries seemed, at the time of the 1950 report, to bear about the same responsibility for the state of affairs, though pollution was reported -- in many instances -- to be heavier on the United States side of the boundary." The Commission, therefore, recommended the adoption of "Objectives for Boundary Waters Quality Control" by the governments of Canada and the United States as criteria to be met in preventing the pollution contemplated by the Treaty.

He further reminded Mr. Frost that the IJC's recommendation was, "after consultation with your Government", accepted by the governments of the United States and Canada and the International Joint Commission was requested to establish and maintain continuing supervision of the pollution of boundary waters in the connecting channels of the Great Lakes system in order to ensure compliance with the "Objectives". (This supervision was accomplished through the Technical Advisory Board of the Commission which co-operated closely with State and Provincial authorities concerned.)

Mr. St. Laurent also told Mr. Frost that Attorney-General Frank G. Millard, of the State of Michigan, had made strong representations to the IJC to the effect that Canada was polluting the water supply of municipalities in Michigan, and, in particular, that of Detroit, in violation of the Boundary Waters Treaty of 1909.

The Canadian Prime Minister did state, however, in the IJC report, that a solution to the phase of the problem dealing with industrial pollution appeared to be in sight and this was a source of satisfaction to him. Nevertheless, the IJC, through General A.G.L. McNaughton, Chairman of the Commission's Canadian Section, had reported to the Canadian Government that the situation with regard to the discharge of municipal sewage and waste in Ontario "continues to cause anxiety."

Mr. Frost replied in a letter dated December 23, 1954, pointing out causes of the difficulties encountered but noting "in recent years, the number of disposal plants in the Province has been increased by 50 percent" and that others had been enlarged, with others in the development stage. "Today the Province has twice as many plants for complete treatment as all the rest of Canada," he wrote.

He added that while the expansion of sewage treatment was progressing in many parts of Ontario, it had, however, made less headway in some of the border municipalities.

"The expenditures required in many of these cases are extremely large and may be beyond the capacity of these municipalities to finance out of their own resources", Mr. Frost wrote. "We recognize the gravity of the pollution problem and the necessity for finding a solution. We are advising the municipalities concerned that it is imperative for remedial measures to be adopted."

But the last paragraph of his letter to the Canadian prime minister was revealing of his attitude to the overall federal-provincial fiscal problems and their relationship to specific problems of water pollution treatment:

> "The pollution of our boundary waters, however, emphasizes the heavy financial burdens and responsibilities that rest upon a Province which has a concentration of industry and population. While the huge industrial development experienced by Ontario had undoubtedly added to the tax resources of the Province and the Federal Government, at the same time it has added very greatly to the demands upon the Ontario Government for the extension of provincial services. For Ontario to earn a corporation tax dollar it has to make many commitments, including the pledging of its credit for the expansion of hydro-electric power, which are not required by a province which receives a corporation tax dollar containing a great deal of subsidy. For this reason, I firmly believe that the abatement of pollution should be considered as part of the broader Federal-Provincial fiscal problem."

Mr. St. Laurent's reply to Mr. Frost, of March 24, 1955, stated:

> "After careful consideration the Canadian Government has come to the conclusion that the abatement of pollution in boundary waters cannot usefully be considered within the context of federal-provincial fiscal arrangements. It should be added, too, that the Canadian Government does not consider that in equity it can undertake to subsidize the construction of essential disposal plants in municipalities situated on boundary waters when, for a number of reasons,

similar treatment could not be extended to communities elsewhere in the country.

"There is an urgent necessity to find a solution to boundary waters pollution, and the prime responsibility for finding the solution rests, we believe, with the Province of Ontario and the municipalities."

Two months later, Mr. Frost replied, stating that the Ontario municipalities concerned,

"have been advised that remedial measures must be taken to minimize pollution. Many of them have had detailed engineering plans prepared, and others have them in course of preparation.

"The problem, of course, extends far beyond those municipalities located on the international boundary waters. It includes many of the communities inland. For instance, representatives of the Government have recently had discussions with the communities in the Grand River Watershed, and it is expected that plants will be brought into operation providing for more complete sewage treatment. Our officials are constantly pointing out to the municipalities concerned the need for full treatment sanitation. As a result of these efforts, many of these municipalities are facing up more realistically to requirements."

Mr. Frost drew Mr. St. Laurent's attention to estimates in a report summary that it would cost Ontario nearly $2.5 billion during the next 20 years to meet these needs. When this was considered, with other fiscal matters, Mr. Frost wrote, "you will see the urgent need of revenues and flexibility of position on the part of the Province. It will also make even the figures discussed in our Federal-Provincial conferences look pretty small."

Mr. St. Laurent's next letter, dated March 7, 1956, appeared to bring to a close that particular phase of exchange between the heads of the Federal and Provincial governments on water pollution problems. However, prior to that date, Mr. Frost had introduced into the Ontario Legislature, on February 23, Bill No. 98, "An Act to establish the Ontario Water Resources Commission." Prime Minister St. Laurent's letter of March 7, made an observation on the "user-pay" principle:

"I would think that the ultimate financing of both water and sewerage requirements could, and probably should, take the form of charges for water which reflect the cost of bringing it to the consumer in a proper condition and the cost of taking it away and disposing of it in the sort of condition in which it can properly be disposed. From what I have been told, there do not appear to be serious objections on any hand to paying the proper cost on a per unit basis for the handling of water in this way. If this were done, it would seem to me it would strike the average person as a very reasonable and sensible way of paying for the services which governments or municipalities or public utilities must provide in this field."

Bill 98 -- "An Act to establish the Ontario Water Resources Commission" was given Royal Assent, March 28, 1956. A. M. Snider was appointed Chairman on May 3, along with four other commissioners. The transition from Committee to Commission was eased by the appointment of Mr. Snider and the naming of J. A. Vance and W. D. Conklin, two other Committee stalwarts, as commissioners. Two newcomers, Mayor Robert Simpson of Arnprior and W. H. C. Brien, Q.C., of Sault Ste. Marie, a former mayor of that city, also were appointed to round out the first ruling body of the Ontario Water Resources Commission.

The setting up of the Commission was well received, with press comment also being generally favourable. Mr. Snider's appointment as Chairman of the OWRC led to many personal tributes -- including one which suggested he might become "the Sir Adam Beck of our time". The late Sir Adam was founder and first chairman of the Hydro Electric Power Commission of Ontario. Coincidentally, it was Mr. Snider's grandfather, E.W.B. Snider of St. Jacob's, who worked closely with Sir Adam and played a prominent part in the setting up of Hydro. In fact, he had first experimented with the production of electricity from water power at the turn of the century.

During all discussions and preparation of reports prepared prior to and during the life of the Water Resources and Supply Committee, it was obvious that southwestern Ontario was the area most requiring attention in the matter of water supplies, with the most favoured sources being the Great Lakes. The obvious means of distribution would be pipelines from the Great Lakes.

The first Commission meeting was held in Toronto, May 17, at 67 College Street, the old Hospital for Sick Children building which had been taken over by the Ontario Government and turned into office accommodation. The particular space used was that formerly occupied by the Committee.

It was at this meeting that Dr. A. E. Berry was appointed Commission general manager and chief engineer, and Brian Larmour was named secretary. Dr. Berry, by now an internationally recognized sanitary engineer and director of the Ontario Department of Health's Division of Sanitary Engineering, was to continue in the latter post, as well, for another year. He had been serving the Committee as a technical adviser, as had J. D. Millar, a deputy minister with the Department of Public Works, who, incidentally, was reappointed in the same capacity by the Commission.

It was the beginning of a Commission which was to become internationally renowned for its achievements in water resource management.

In 1957 the Commission began its programs as provided for in the Ontario Water Resources Commission Act, 1957. The Act underwent many amendments in the following years but its basic provisions remained intact, giving the Commission two broad assignments; one, to build, finance and operate water and sewage projects for municipalities - the other, to exercise supervision over the water resources of the Province including water supplies and waste disposal facilities, and to control the use of water.

Construction and Operation

The program for water and sewage works construction and operation was a distinct departure from the procedures of the past, or the practices of

most other environmental jurisdictions throughout the world. The object was to help municipalities meet their requirements for these projects. The Commission offered financial advantages as well as expert technical assistance in the planning, construction and operation of works.

Municipalities were able to construct their own facilities, or enter into agreements with the Commission whereby the Commission would undertake design, build, finance and operate the facilities. The agreement on a project could involve one or several municipalities as well as industries. Operation of the works was provided by the Commission for the lifetime of the debt. Operating personnel were the employees of the Commission although their costs were included in the payments made by the municipality. At the termination of the debt there was provision in the agreement whereby at the request of either party the works could be returned to the municipality.

Under the financing plan offered by the Commission, the municipality did not have to issue debentures. The money was supplied by the Commission and the debt paid over a period of 30 years in most instances. Interest was charged based upon the cost of money to the province, which was normally lower than that available to a municipality borrowing funds on its own.

Over the years there were changes to the financial approaches offered by the Commission; the most significant changes included a "provincial project" funding developed during the mid 60's. In this arrangement, a service rate in cents per thousand gallons was charged by the Commission for water or sewage treatment services. The rate was based upon expected flows over a twenty year period of time, anticipated costs during that time, including operating and capital expenditures, and a break-even situation at the end of twenty years.

The project could operate, and in fact most did, in a deficit position during the initial years while the population and flows were smaller, with a break-even position being achieved in twenty years time. Interest on the capital debt was normally based on a forty-year amortization period which was intended to give some added advantage to the municipality. Philosophically, the approach was to recognize that the facility initially constructed would be larger than needed for the current population, was designed to provide for a long period of service and that cost should be borne by those benefiting from the service. This meant that the initial population would not carry the total debt load but, as the population grew, the additional residents would contribute to the payments of the facility. The first generation served by the facility would not carry the total cost of providing services which would also serve future generations. This approach was compatible with the steady population growths being experienced or expected by the municipalities. Inflation during the late 60's and early seventies, coupled with a lack of growth in many municipalities, resulted in many experiencing rapid increases in the rates being charged for service.

The second change in the financial approach involved the provision of subsidies or grants by the Province for water and sewage works. These programs began in the late 60's, resulting from the need for greater assistance to small communities in particular, as a result of the rapid inflation and small population available to service the debt. The program also recognized the advantage of scale and included subsidies for area type projects. The grants have increased over the years such

that by April 1, 1985, the maximum grant for a small community could be 85%, diminishing to 15% for the larger community. The grant program also, as of April 1, 1985, included a subsidy of up to 25% for rural water service.

The ambitious construction program of the Commission during the formative years was under the able direction of Allan W. Shattuck, Director of the Division of Construction for the Commission from 1958 until his retirement in 1971. In recognition of his contributions, the A. W. Shattuck bursary was established through the University of Waterloo for students in Civil Engineering who had a high scholastic ability and a need for financial help.

The first Director of the Plant Operations Division was David S. Caverly who later succeeded Dr. Berry as General Manager of the Commission. He most ably served as General Manager from 1963 until the Commission was dissolved in 1972, subsequently to become absorbed in the newly-created Ministry of the Environment.

Sanitary Supervision

The other major part of the Commission's program involved sanitary supervision of the water and sewage plants, stream pollution, ground waters, and industrial water discharges. All plans for water and sewage works installations or extensions to existing works required the approval of the Commission before construction was undertaken. The Commission had wide powers to protect the safety of water supplies. These powers were not confined to public health but rather were widened to include anything which might impair the quality of the water.

Industrial wastes were a major concern of the Commission and a separate branch was established for this sector. During the initial years of the Commission, much technical assistance was provided to industry through the Commission's staff and facilities and much of their approach involved persuasion and negotiation.

George Galimbert and Ken Sharpe were Assistant General Manager and Director of the Division of Sanitary Engineering, respectively, during the formative years of the Commission. Ken Sharpe later became the Deputy Minister of the Ministry of the Environment. One of Dr. Berry's proud accomplishments was the creation of a world-class laboratory specializing in the field of sanitary engineering. The laboratory was opened in 1960 under the directorship of A. V. (Cap) DeLaporte and has expanded and its scope has broadened particularly following the formation of the Ministry of the Environment, providing an analytical service for the entire environmental field. By 1984, the lab was annually performing some 2 million analyses on a vast spectrum of complex environmental problems. The array of electron microscopes, emission spectrographs, mass spectroscopy units and gas chromatographs enable some samples to be analysed at concentrations as low as parts-per-quadrillion.

This lab is one of the many reasons the OWRC gained an international reputation before it dissolved to become a major part of the Ontario Ministry of the Environment.

The Creation of the Ministry

Len Webster, for many years both a columnist and editor of Water & Pollution Control, was among the many who lamented the passing of the OWRC, with the creation of the Ministry of the Environment. Len had frequently criticized OWRC actions and staff with wit and skill over the years. However, he was saddened by the loss of a Crown Corporation which, he wrote, had gained an international reputation for its technological expertise and a record for integrity second to none.

The engineering historian, Dr. Robert Legget, has frequently noted that the OWRC had gained an international reputation.

The Ministry of the Environment was established April 1, 1972, (The Department of the Environment had been created a year earlier). Following the formation of the Ministry, a major organizational study was initiated by the Ministry's first Deputy Minister, Everett Biggs. The organizational considerations involved two parts; firstly the structure required to bring the various functions of the new Ministry together as part of one organization, and, secondly, the regionalization of the Ministry. These changes were completed by April, 1974, when six regional offices across Ontario were officially opened and a new overall organization including air, water and land pollution considerations came into being.

The Ministry has continued with the programs initiated by the Ontario Water Resources Commission but its overall role has broadened greatly to include all environmental concerns. Emphasis has changed to respond to concerns of toxic chemicals, solid waste disposal, liquid industrial wastes and protection of the ecosystem. With these changes has come public involvement and greatly increased public participation. These have been reflected in lengthy hearings for landfill sites, the formation of citizens groups and the increased media coverage of events in the environmental field. These concerns go beyond environmental considerations to include implications for long-term health effects of humans and is currently placing pressure on health people, particularly the Ontario Ministry of Health, to conduct studies and provide assurances of the protection of health from environmental pollution. This evolution completes a cycle which began with environmental concerns being a part of the responsibilities of the health agencies; it grew so that it required the creation of an environmental agency to cope with them and, now that health concerns are becoming a major consideration within the context of environmental pollution, new demands are being placed on health agencies to respond.

The goal of the Ministry of the Environment was to achieve and maintain a quality of the environment, including air, water and land, that would protect human health and the ecosystem and would contribute to the well-being of the people of Ontario. Since then seven ministers have held the office. They are:

George A. Kerr: Department of the Environment April 1971 - February 1972,

The Late James C. Auld: February 1972 - February 1974.

William G. Newman: February 1974 - October 1975.

George A. Kerr: October 1975 - January 1978.

George McCague: January 1978 - August 1978.

Dr. Harry C. Parrott: August 1978 - April 1981.

Keith C. Norton: April 1981 - July 1983.

Andrew S. Brandt: July 1983 - February 1985.

The Honourable George A. Kerr, Q.C., was appointed Minister of the Environment on October 7, 1975. In reality, he was Ontario's first Environment Minister in a previous term, when he was appointed Minister of the Department of Energy and Resources Management in June 1969. In 1972, this Department, through additions and alterations, became the Department of the Environment. Earlier, Mr. J. J. Simonette, as Energy Minister, had some measure of influence on Environmental matters but Mr. Kerr is acknowledged as the first "true" Minister of the Environment in Ontario.

Mr. Kerr held the Cabinet positions of Minister of the Department of Colleges and Universities (appointed February 1972); Provincial Secretary for Justice (appointed September 1972) and Solicitor-General (appointed February 1975).

Mr. Kerr represented Halton in the Ontario Legislature from 1963 until 1975, when he was elected to represent the new riding of Burlington South. He has served on a number of government committees including the Standing Committee on Municipal Affairs, the Select Committee dealing with Consumer Credit, and the Select Committee on Conservation Authorities and Water Resources.

The late James Auld was appointed Minister of the Environment on February 2, 1972. He first entered politics in 1951, when he was elected an alderman in the City of Brockville. His career at Queen's Park was launched by a 1954 by-election victory in the riding of Leeds, in which Brockville is the largest municipality. Mr. Auld was re-elected in the general campaigns of 1955, 1959, 1963, 1967, and 1971.

For a number of years, Mr. Auld served as vice-chairman and acting chairman of the St. Lawrence Parks Commission. Prime Minister John Robarts appointed him to his first portfolio as Minister of Transport in October, 1962. Shortly thereafter, he was named to the Management Board of Cabinet. In 1963, Mr. Auld became Minister of Travel and Publicity, later to be called Tourism and Information. That Department had jurisdiction over such tourist attractions as Upper Canada Village, the St. Lawrence Parks, Old Fort Henry, Sainte-Marie among the Hurons, and the Ontario Science Centre.

He was also responsible for the beginning of the reconstruction of Old Fort William at Thunder Bay, which was the original base of the Northwest Company.

On March 1, 1971, he was appointed Minister of Public Works. This department had responsibility for an overall construction and policy budget of 108 million dollars. He held the folio for almost one year before being appointed Minister of the Environment.

The Honourable George R. McCague was appointed Ontario Minister of the Environment on January 21, 1978.

In 1960, he began a 13-year career in municipal politics, serving the last four as Mayor of Alliston. In 1973, Mr. McCague left that post following his appointment as the first Chairman of the Niagara Escarpment Commission. After entering the Legislature in 1975, representing Dufferin-Simcoe riding, Mr. McCague served as a Member of the Select Committee on a Proposed Hydro Rate Increase and as a Member of the Select Committee on Highway Safety. In March, 1977, he was appointed Parliamentary Assistant to the Provincial Treasurer, Darcy McKeough, and served in that capacity for six months before his appointment as Minister of Government Services in September, 1977.

The Honourable William G. Newman became Minister of the Environment on February 26, 1974. An agrologist, he graduated from the University of Toronto Schools and the University of Guelph (B.S.A. P.Ag.). He served on Pickering Township council for seven years as Councillor, Deputy Reeve and Reeve. Elected MLA in October, 1967, he was appointed Deputy Government Whip in March, 1971. He was a member of the Estimates Committee and the Natural and Physical Resources Committee before being appointed Parliamentary Assistant to the Minister of Transportation and Communications in March, 1972.

The Honourable Harry Craig Parrott, D.D.S. was appointed Ontario Minister of the Environment on August 18, 1978. His appointment coincided with a surge of public concern over land facilities, ground water contamination and other highly contentious issues.

Dr. Parrott entered politics in 1953 as a member of the Woodstock Board of Education and served for three years. In 1961, he was first elected to the Woodstock City Council and served for five years. He was also elected to the Woodstock Public Utilities Commission and served on the Woodstock Traffic Committee, the Industrial Commission and the Upper Thames Valley Conservation Authority. First elected to the Ontario Legislature in October, 1971, representing Oxford riding, Dr. Parrott served as a member of the Select Committee of the Legislature to study the Ontario Municipal Board. In April, 1974, he was appointed Parliamentary Assistant to the Minister of Colleges and Universities, and later became the Minister of Colleges and Universities.

A sensitive man, Dr. Parrott clearly was hurt by the sting of public criticism and he left public life by not seeking re-election in the 1980 Provincial election. Although he was frequently criticized by citizens' groups, Dr. Parrott enjoyed the widespread respect of the engineering and scientific professionals in the environmental disciplines.

The Honourable Keith C. Norton, Q.C. was appointed Minister of the Environment on April 10, 1981.

He practised law in Kingston from 1971 until his election to the Ontario Legislature in September, 1975, and was director of Legal Aid at the Faculty of Law, Queen's University, from 1973 to 1975. Mr. Norton served as an alderman for the City of Kingston from 1973 to 1975, and was Deputy Mayor at the time of his election to the Ontario Legislature as MPP for Kingston and the Islands in 1975. He served as Parliamentary Assistant to the Treasurer in 1976 and as Minister of Community and Social Services from February 1977.

The Honourable Andrew S. Brandt, MPP for Sarnia, became Minister of the Environment in 1983.

Mr. Brandt was determined to have an 'open' Ministry. He immediately ran into a storm of criticism on various issues. Much of this criticism was slanted and clearly unfair. For example, after he said he was going to **review** the beach pollution standards, critics immediately and erroneously took this to mean he would **lower** the standards. In Andrew Brandt, however, the critics had someone who would fight back. "As I understand it, in the English language, the word **review** does not commit you to lowering anything; the word means you are going to check into the process." But, the Minister had a warning for industrialists "who are hell bent on expansion .....without concern for the environment." He said, "If we are going to err, we have to err on the side of the environment."

He was elected to Sarnia City Council as an alderman in 1971 and re-elected in 1973. From 1975 to 1981, Mr. Brandt served three terms as mayor of the City of Sarnia. He was elected to the Ontario Legislature in March, 1981, and, two months later was appointed Parliamentary Assistant to the Minister of Labour. He served on the Legislature's Standing Committee on General Government, the Standing Committee on Regulations and Statutory Instruments, the Standing Committee on the Administration of Justice, the Select Committee on Pensions, and the Regulations Committee of Cabinet.

He is a life member of the American Federation of Musicians, a member of the Sarnia and District Chamber of Commerce, and a former vice-president and member of the board of directors of the Association of Municipalities of Ontario. As those attending a party for PCAO President Grant Mills in 1983, found out, Andy Brandt has a wickedly witty sense of humour which few can match.

CHAPTER SEVEN

INDUSTRIAL WASTE MANAGEMENT IN ONTARIO

Ontario Industrial Waste Conference

In the early fifties, an era of public apathy -- which contrasts strongly with the acute public concern of today -- plans were laid for the first Ontario Industrial Waste Conference (OIWC).

It was sponsored by the Pollution Control Board of Ontario, a body of public servants appointed by the, then, Premier Leslie Frost.

The first conference was held in 1954, at the Ontario Agricultural College in Guelph, under the chairmanship of Dr. Berry. The historic first conference comprised a diverse range of excellent papers covering such topics as: Group Research, Utilization of Mine Wastes, Treatment of Oil Wastes, Nitrates in Rural Water Supplies, Deoxygenating Wastes, Spray Irrigation to Dispose of Cannery and Milk Wastes, Treatment of Beet Sugar Wastes, Setting up an Air Pollution Survey, Pollution in Relation to Stream Life, Pollution and Water Fowl, Pollution and the Fisheries. Excerpts from a presentation by E. G. Hachborn, a design and sanitation engineer from Kitchener, Ontario, are highly revealing of the industrial pollution problems which prevailed decades ago:

> "For years the discharge of industrial wastes into sewers and storm drains has been permitted by municipalities with very little regard for the possibility of menace to public health and safety, potential damage to the system or increased cost of maintenance and operation of their sewage treatment plants.
>
> In many cases the results have been serious both to the community and the industry. Many cities have been forced to install sewage treatment plants to prevent pollution of rivers and streams, and, too frequently, industrial wastes have caused deterioration of the structures and interference with sewage treatment processes.....There is a serious hazard to workmen because of toxic gases and explosion hazards in sewer mains. On the other hand, industries have been slow to realize the possibilities of by-products from the waste they discharge.....The rapid expansion which we are experiencing today, makes the establishment and enforcement of an ordinance imperative.....
>
> In 1932, a gasoline explosion in Montreal injured 30 persons, tore up 12 blocks of sewers and resulted in damages of over a million dollars.....An explosion in a sewer in Kitchener raised a manhole top to the height of the post office block. Fortunately, no one was killed, however a pedestrian had a button wiped off his spat as the manhole casting fell to the ground.....Kitchener last year (1953) was forced to close one of their sewage treatment plants for a few days as a result of a broken valve at one of the oil companies. There was luckily no fire, but an extreme hazard existed for some days.

> Sewer clogging is usually due to the accumulation of grease, roots and miscellaneous debris.....large amounts of hair from tanneries, feathers from poultry establishments, wool fibres from textile plants, spent grain from breweries have caused many instances of clogging, not only in the sewers, but throughout the treatment plants as well. Kitchener has experienced difficulties with every one of those (problems) mentioned, probably to a greater extent at its sewage treatment plants, than in the sewers themselves. However, a 48 inch sewer, built in 1912, has had its effective diameter reduced to less than 3 feet and its velocity to only a few feet per minute because of the accumulation of hair on the walls of the sewer. This hair has been coated with chemical salt deposits, which give it a fabric-like protection, making cleaning possible only by mechanical means.
>
> Serious overloads have been caused by the discharge of great quantities of process water and cooling water into municipal sewers.....
>
> The effects on sewage treatment processes are many. Acid pickling liquors have caused very low pH values. Hair has caused severe clogging as well as formation of thick mats of scum in the tops of digesters, greases from packing plants have caused clogging of pipelines, diffuser plates and other elements of a plant, not to mention the effects of extremely high BOD and suspended solid rating of some industrial wastes.....Gas production from Kitchener's sewage is more than twice that of normal domestic sewage because of the high solids content."

After discussion of ways and means to limit hazardous industrial discharges into municipal sewers, including the encouragement of industrial in-plant, pre-treatment before discharge into municipal sewers, the author outlined suggested penalties:

> "It is necessary to decide on a maximum penalty that would serve to deter wilful continued or occasional violation by an offender who might find payment of the penalty less expensive than compliance. Those set forth in various ordinances vary from a minimum of $1.00 to a maximum of $500.00. A maximum of $200 has been suggested.....it would be best that a notice of violation fix a definite time limit for correction of the objectional condition.....best varied to suit the nature and extent of the necessary improvement."

If the suggested penalties seem minor in nature by today's standards, the program of the Second Ontario Industrial Waste Conference at the same location also gives some revealing insights into costs in the pre-inflationary era. In 1955, the conference registration would set you back $3.00, while a room and meals could be had for $3.50 per day.

In 1956, the Ontario Water Resources Commission was formed and naturally took over the responsibility for the OIWC. Later, the conference moved to the Delawana Inn at Honey Harbour, where it stayed for eight years before moving to Bigwin Inn, in Muskoka.

Over this period, the OIWC was developing an international reputation. It not only attracted experts from other countries, but a growing number of people came from overseas because of the quality of the presentations. Partly because of this international aspect -- and to handle the growing registration -- the location was changed to Niagara Falls in 1966, where it stayed until 1971.

The conference has not been without its lighter moments. One year it was found that the sewage treatment plant serving the Honey Harbour area was not working well. The plant could not have chosen a better time to malfunction. In the area were some of Canada's finest wastewater treatment engineers. Honour was at stake. Dave Caverly, then conference chairman, selected a body of men who sought out and rectified the fault.

Another OIWC incident is often recalled with amusement when conference veterans reminisce. In 1969, food poisoning struck down many delegates attending the Niagara Falls conference. At first, session chairmen were puzzled by the abrupt departure of people in the audience. No doubt, too, some authors erroneously felt their presentations were lacking in style and substance. But the culprit was not the program but salmonella; which caused one scientist to observe he'd never seen such widespread interest in fluid mechanics -- and it wasn't even on the program!

In 1972, the OIWC moved to Toronto's Prince Hotel where it has remained until the time of writing. A comparison of the technical content of conferences shows how the OIWC has grown in sophistication and social awareness over the past three decades. Problems and issues, undreamed of in earlier times, are now routinely discussed at the meetings.

During its 25th Anniversary meeting, the OIWC devoted an entire session to nuclear waste disposal problems, as well as numerous papers on industrial waste treatment. Papers such as The Importance of Citizen Participation in Environmental Assessment; Economics and Environmental Strategies; Acid Rain; and assorted viewpoints on the myriad legal complexities in environmental matters all showed an increasing OIWC awareness of interdisciplinary matters.

Clearly the conference has evolved in the scope and depth of its contents as it grapples with the growing complexity of industrial wastes. While OIWC has performed an admirable role in advancing the state-of-the-art in pollution abatement, the beneficial effects of its efforts--regrettably--remain almost totally unknown to the general public.

ONTARIO INDUSTRIAL WASTE CONFERENCE HISTORICAL DATA

Location	Dates	Sponsor
Ontario Agricultural College, Guelph	1954 to 1956	Pollution Control Board of Ontario
Delawana Inn Honey Harbour	1957 to 1963	Ontario Water Resources Commission, Water and Pollution Advisory Committee

Location	Dates	Sponsor
Bigwin Inn Lake of Bays	1964 and 1965	Ontario Water Resources Commission, Water and Pollution Advisory Committee
Park Motor Hotel Niagara Falls	1966 and 1967	Ontario Water Resources Commission
Sheraton Brock Hotel, Niagara Falls	1968 to 1971	Ontario Water Resources Commission
Skyline Hotel Toronto	1972 to 1974	Ontario Ministry of the Environment
The Prince Hotel Toronto	1975 to 1984	Ontario Ministry of the Environment

Conference Chairman	Dates	Secretary/ Co-ordinator
Dr. A. E. Berry	1954 to 1962	D. S. Caverly/M. Grove
D. S. Caverly	1963 to 1973	L. M. Tobias
K. H. Sharpe	1974 to 1976	M. J. Cathcart (1974)
D. P. Caplice	1977 and 1978	M. F. Cheetham (1975-1978)
J. W. Giles	1979 to 1984	M. F. Cheetham (1979 - 1984)

PROGRAM CONVENER

1960 - 1973	F. A. Voege
1974 - 1978	J. B. Patterson
1979 - 1984	R. C. Stewart

The Ontario Waste Management Corporation

In the early 1980's, mounting public concern over industrial toxic wastes completely overshadowed Ontario's remarkable progress in environmental management.

Critics at Queen's Park, as well as in the news media, relentlessly attacked the Conservative Government's record in environmental protection. Lost in the furore was the province's unmatched record in building sewage treatment facilities. In addition, this province's industries had a commendable record in building treatment plants for most of their contaminated wastewater.

But in the eighties, horror stories like New York's Love Canal aroused well-founded concern that society had been careless with its concentrated industrial wastes and the government's record was increasingly scrutinized and, with some good reason, criticized. Few critics, however, noted that even environmentally-enlightened countries like West Germany, Sweden and Great Britain faced similar problems.

To cope with the growing public concern, The Ontario Waste Management Corporation, a provincial crown agency, was created on July 2, 1981 by

the Ontario Legislature. OWMC's primary responsibility is to establish and operate a liquid industrial waste and hazardous waste management system in Ontario. It has no responsibility for managing municipal solid waste or radioactive waste, nor is it a regulator of other industrial waste management systems.

One of OWMC's first tasks was to examine the possibility of constructing a treatment and disposal facility at South Cayuga in the Regional Municipality of Haldimand-Norfolk. A site at South Cayuga had been tentatively selected by the government, before the establishment of OWMC. Preliminary hydrogeological studies of the site conducted for OWMC revealed that it had several shortcomings. The Board of Directors of OWMC voted unanimously to reject the site in November 1981.

Following the rejection of the South Cayuga site, OWMC conducted a series of meetings with the public in early 1982 and began to develop a broad corporate plan. Several major issues were identified:

- The need to design and build a waste treatment and disposal system to safely manage liquid industrial waste and hazardous waste not presently receiving adequate treatment and disposal in Ontario;

- The need to assist Ontario industries in identifying additional ways to reduce and/or recycle liquid industrial waste and hazardous waste, thus reducing the need for treatment and disposal;

- The need to consult with the public on the nature and scope of the industrial waste problem and how it can be remedied.

Before a treatment and disposal facility can be built, OWMC must present its detailed proposals to an independent Hearing Panel on Industrial Waste Management, appointed by the Ontario Government for the purpose of conducting formal, public hearings on OWMC's proposals. Following these hearings, the Hearing Panel will submit a report to the Ontario government on the safety and suitability of the Corporation's proposals.

A five-phase Facilities Development Process was designed to prepare these proposals. Phase 1, completed in September 1982, defined the nature and size of the industrial waste problem, described possible treatment technologies and the hydrogeological conditions throughout Southern Ontario (the underground rock and soil conditions and how they affect underground water movement), and outlined the engineering, planning and environmental issues that should be considered in later phases. Preferred hydrogeological conditions - specifically, a thick uniform clay deposit - are an important site requirement, to avoid total reliance on engineered safety features for the containment of toxic residues. Phase 2, completed in January 1983, resulted in the search for sites being narrowed to the Golden Horseshoe region of Southern Ontario.

The specific objective of Phase 3 was to select candidate sites which may be suitable for one or more of the facilities outlined in Phase 2 (incinerator, physical/chemical treatment plant, engineered landfill). In May 1983, a Phase 3 Interim Report was issued which described 19 candidate areas within the highly industrialized area around the western end of Lake Ontario from Oshawa to Niagara Falls where the search for these sites would be concentrated, and which outlined the search and selection method to be used. Since then, these candidate

areas, including an additional area announced by the Corporation in January 1984, have been examined in detail in consultation with the general public and federal, provincial, regional and local planning officials.

Two important steps remain in the Facilities Development Process. First, the candidate sites must be studied and compared in greater detail before a preferred site or sites can be selected. Second, the preferred site or sites must then be subjected to detailed, on-the-land investigation, prior to the submission of OWMC's proposal to the Hearing Panel on Industrial Waste Management appointed by the Ontario Cabinet to conduct formal public hearings on the proposal. This was the situation as this book was going to press. Clearly OWMC has much to accomplish in the immediate future.

Given the benefits of hindsight, clearly Ontario has not done enough in fully anticipating the industrial waste problem, the full extent of which is just beginning to emerge.

However, it says much for Ontario's professional environmentalists that they had started to focus on industrial pollution three decades ago, when such matters were but a fleeting concern in a society overwhelmingly devoted to GNP growth.

While many people naively assume that toxic problems from industrial activities can virtually be legislated away, the real experts know that remedial action can only be successful through the sustained efforts of scientists, engineers, regulatory personnel and politicians.

Industrial Initiatives

Few Canadians realize the very substantial efforts which industry has often voluntarily made to achieve a cleaner environment. To be sure, there are horror stories where regulatory compliance was accomplished grudgingly, if at all; but, not all industrial concerns show a callous disregard for the environment. Research shows that many industries exhibited ecological sensitivity over three decades ago, years before the current public concerns developed.

Lambton Industrial Society

When this pioneer industrial environmental cooperative was organized in 1952 to monitor air and water quality on the Canadian side of the St. Clair River, it had three members and was known as the St. Clair River Research Committee.

As a basis for its studies of water quality, a series of benthic studies was carried out by Tom Beak. These have been repeated at regular intervals over the 30 year period and serve to indicate the improvement in water quality attained as a result of industry's increased attention to plant discharges.

A major turning point in the organization of the Society took place in 1967 when, in response to the increased importance of environmental concerns, the group acquired a provincial charter, changed its name to Lambton Industrial Society (LIS) and hired a manager. This marked the beginning of a period of active growth as the Society gained recognition

for its seminars and technical meetings as well as for the monitoring and analysis.

In recognition of the work of the manager, J. A. McCoubrey, in the field of environmental education, the Board of Directors established a scholarship in his name at the local Community College.

During over 30 years of operation, this voluntary group has grown to represent 15 companies which have $5 billion in assets and employ 12,000 people. The membership currently includes all the major chemical and petrochemical operations in the area. LIS spends about $750,000 annually in air and water quality monitoring. The Society provides and exchanges environmental information within the member firms and government agencies; but it does not relieve any individual company of its environmental responsibilities.

One LIS spin-off was Operation Bluewater Clean which has over $1 million invested in oil spill control equipment at the ready to minimize the impact of any spills in the St. Clair River. While Bluewater Clean is now operating under the umbrella of the Petroleum Industry Marine Environmental Co-operative, it grew directly from the Society's concerns for water quality.

At the 1981 Annual meeting, LIS President Ed Scheer said:

> "We now make more efficient use of our waste products, through recycling into the processes. We are finding and using more effective ways of making waste innocuous through treatment, and for the products which we cannot yet recycle, technically sound and safe disposal systems such as Tricil here in Sarnia have been developed."

In 1981, the Society's annual meeting was told "large populations of fish can be found in the St. Clair River and Lakes Huron and St. Clair." Recently, Mr. Mackenzie, Manager of The Ontario Council of Commercial Fisheries said "fish populations of the Great Lakes are coming back like gang busters", and "recreational fishing has never been as good in this region as it is today."

The LIS program on water quality investigations in 1980 included two principal components; ongoing monitoring of fish and water quality at observation stations along a 25 kilometre stretch of the St. Clair River; and an expanded developmental program on techniques to measure the impact of volatile organic compounds on fish exposed to St. Clair River water at the same observation stations.

Primarily, LIS assesses the quality of the near-shore band of water since it represents the extreme case when compared with water quality in the main channel. For several consecutive years, the work has been performed by Pollutech Limited, an independent environmental consulting firm based in Oakville, Ontario. Monitoring stations are equipped with tanks holding rainbow trout for extended periods of time. Water from the near-shore bank is pumped through the fish tank and returned to the river. Rainbow trout are used because it is a native species and extremely sensitive to pollution.

What some believe was a pioneering step was the evaluation of the taste and the aroma of fish flesh, carried out in tests performed by a

selected panel of students who were both non-smokers and non-drinkers. A tank upstream of the LIS area is used as a control station for comparison with the downstream test tanks.

In 1980, an interesting sideline of the regular monitoring program was an evaluation of river water to determine the off-shore limit of industrial discharge effects along the most heavily industrialized section of the river. The tainting level of fish exposed to the river water 75 metres offshore was significantly lower than the level at the near-shore intake. The results indicated that the majority of the St. Clair River, even in the most industrialized section, remains relatively unaffected by industrial operations.

This practical look at the river's quality backs up the Ontario Ministry of the Environment's theoretical studies of dispersion in the St. Clair River.

An extension of the program, designed to evaluate the washout or self-purification abilities that fish may have to these organics, was being developed in 1981. In this study, fish are deliberately exposed to water from the near-shore band to evaluate the worst available conditions - and are then exposed to upstream water to evaluate to what extent fish can purge volatile organic compounds from their systems. This washout potential could be very important because fish tend to leave areas that are unpleasant for them and move on to cleaner water.

The Society's optimism was echoed in an Ontario Ministry of the Environment report which concluded that the quality of the St. Clair River is "remarkably good considering the degree of industrialization."

The 1981 annual meeting was told that the 15 member companies of the Lambton Industrial Society were committed to continue investments in equipment and better techniques to maintain and improve the water quality, and, through continuous monitoring by independent consultants, to confirm the effectiveness of these environmental programs.

In 1983, in the November issue of Water & Pollution Control, Andrew Brandt, Ontario Minister of the Environment, held out the LIS as a model for others to follow. "If they had this kind of thing in New York State, I don't think you'd have had a Love Canal situation."

Petroleum Association for Conservation of the Canadian Environment

Another Industrial Association making a contribution to water quality is the Petroleum Association for Conservation of the Canadian Environment (PACE).

Since its inception in the early 1970's, PACE has been working quietly but efficiently to improve the quality of waters discharged from refineries into the Great Lakes.

PACE is made up of 10 companies, ranging from large to small, that contribute manpower and money to a wide variety of activities related to pollution control in the industry. By pooling information and resources, the industry has been able to fund research projects to find solutions to common environmental problems, and to find ways of protecting the environment in the petroleum refining, transportation and marketing networks.

PACE assists government agencies and such bodies as the International Joint Commission by providing technical comment on proposed legislation and water quality objectives for the Great Lakes. It identifies and carries out research studies to fill information gaps in environmental knowledge. The Association also carries out an educational role on environmental issues, for members of industry and others.

As an example of research work, PACE, in conjunction with Environment Canada, sponsored a study of sublethal effects of treated petroleum refinery effluent water. Effects on growth, reproduction, avoidance behaviour and life stages of rainbow trout and a species of water flea called Daphnia pulex were examined. The study concluded that with the high level of treatment currently in practice, none of the effects measured in the study would be evident at the periphery of a mixing zone.

Another research project funded by PACE was to look for trace substances in industry effluents that may have toxic effects. Sampling and analytical methods received special attention because of the very low levels likely to be encountered (parts per billion or parts per trillion range).

In the field of education, PACE periodically holds workshops for people who design and operate wastewater treatment plants. These forums stimulate new ideas and lead to more efficient industrial water treatment design and operation.

In 1981, Chairman Budzik said, "the Association is continuing to support research to expand the trace substances survey, look at mathematical modelling of mixing zones and other potential biological impacts of treated wastewaters, and will be continuing its education program mainly in aquatic toxicology for this year."

PACE supports the goals of the International Joint Commission and is hopeful that the results of the PACE research programs, and other technical input, will make a contribution to the continuing success of the work of the Commission.

Case Histories

As few people seem aware of the technical details of industrial pollution abatement, some technical data on the contributions of several industries have been compiled. These projects are as noted in Chapter 12 and include: The Rapson/Reeve Process, Stelco, Dofasco, General Motors, Ontario Hydro, Deepest Plant in Ontario, and the Polysar Biox Plant.

CHAPTER EIGHT

THE FEDERAL ROLE

The Canada Centre for Inland Waters

Although this book is largely confined to Ontario activities, it is important to note that a significant Federal facility is located at Burlington, Ontario, in the shadow of the Skyway Bridge.

In 1967, the Government of Canada created the Canada Centre for Inland Waters (CCIW), now shared by Environment Canada and the Department of Fisheries and Oceans. From a cluster of trailers, a small group of scientists set out to find the answers to diverse Great Lakes problems. Through specially equipped research ships and other facilities, they undertook the slow, painstaking task of assembling a giant jig saw puzzle of information. Some of the information needed had already been acquired by these and other scientists from earlier research. Where before such information alone had been insufficient, now, in light of an expanded and concentrated program of learning at CCIW and elsewhere, it acquired new value and new meaning.

Permanent buildings now replace the trailers and accommodate the scientists and their programs.

In the first two years of the Centre's existence, its main task was to provide much of the important scientific research behind the report to the International Joint Commission on the pollution of the lower Great Lakes and the St. Lawrence River. Also contributing to this report were the Ontario Water Resources Commission, the Freshwater Institute of Canada and several United States agencies. Eutrophication--the production, by nutrient over-enrichment, of far more plant life than the lakes can sustain--was named as the most urgent problem. The report also defined phosphorus compounds as the most controllable cause of this over-production of algae which, as it dies, causes the removal of oxygen from the bottom waters. This research was responsible for the enactment of new water management legislation and programs at both the federal and provincial levels of government in Canada. That legislation included Federal regulations limiting phosphates in detergents. The report's findings and recommendations were also an important key to an agreement between Canada and Ontario and to negotiations between Canada and the United States for pollution abatement programs in the lower Great Lakes.

The report to the IJC was further reinforced by the findings of another important study by the Centre--a study in which U.S. scientists also took part and which was called "Project Hypolimnion". Project "Hypo" as it became known, set out to determine the extent of oxygen depletion in the bottom waters of Lake Erie. The findings surprised even the scientists themselves. Consequently, the governments at several levels in Canada and the U.S.A. embarked on a program to advance by two years the earlier deadline set for phosphorus removal at sewage treatment plants discharging into Lake Erie. The Government of Canada, therefore, agreed to advance $167,000,000 in loans and grants to assist the provincial and municipal governments of Ontario, as well as a further $3,000,000 to aid in research toward better and cheaper methods of nutrient removal. Project "Hypo" also lent new urgency to the Canadian

government's detergent phosphate control program. With the resulting reduction in phosphorus input, algae production was drastically reduced and the oxygen concentration in Lake Erie significantly improved.

These are but two of the contributions to better water management made by the Canada Centre for Inland Waters. Others involve important studies of mercury distribution in the sediments and methods for safely removing it; studies on NTA--sodium nitrilotriacetate--a contender to replace phosphates in detergents; microbiological surveys; the development with other agencies of a national contingency plan to deal with spillage of oil and other toxics; the study of waste heat input to lakes and rivers and its possible ecological effects; work at pilot plant scale of promising new sewage and industrial waste treatment methods; studies in hydraulics; remote sensing of water resources; shore erosion and sediment movement; and diffusion and movement of pollutants in lakes. In addition to these activities, the Centre is also responsible for the collection of all data and production of nautical charts to ensure safe shipping and boating in Central Canada.

In 1974, the World Health Organization (WHO) chose the Canada Centre for Inland Waters as its international reference centre on surface and ground water quality. The basic role of the WHO Collaborating Centre on Surface and Ground Water Quality is to provide developing countries with technical assistance in all aspects of water management.

Added to that responsibility in 1977 was the task of organizing a worldwide water quality monitoring network, part of the United Nations Global Environmental Monitoring System (GEMS/Water). Under the GEMS program, Canada has helped set up more than 400 monitoring stations in 62 countries, has trained personnel in many languages and has created a computerized system to store and analyze masses of data.

Besides coordinating the monitoring network and arranging for Canadian expertise in water management to be shared with developing countries, the WHO centre publishes the quarterly journal Water Quality Bulletin which is distributed in more than 120 nations.

Although Environment Canada was not created until the early 1970's, the Federal presence has played a vital role in pollution abatement. The Federal initiative has been overlooked largely because, over the years, several ministries had responsibilities which had environmental implications.

K.E.B. Symons, former Director of the Pollution Control Branch, Ontario Ministry of the Environment, pointed out in an interview that the Federal involvement goes back as far as 1909 when the International Joint Commission Treaty was signed. A survey of the Great Lakes followed in 1912, funded by the Federal government.

Mr. Symons said that the Federal departments, such as Fisheries, Energy Mines and Resources, and Health and Welfare all have played a role in Ontario's environmental progress.

The IJC Treaty was especially significant to Ontario because of the fact that it is the only Canadian province fronting the Great Lakes, as well as a considerable stretch of the St. Lawrence River. All the Great Lakes, with the sole exception of Lake Michigan, touch Ontario shores, giving both national and international implications to the Province.

Mr. Symons said one very important Federal contribution was made in the post World War II era, when funding from Ottawa enabled many young Ontario engineers to complete post graduate studies in sanitary engineering or related disciplines. Mr. Symons himself received Federal funding, enabling him to gain a Master's Degree.

Many of those young engineers later became key figures in the rapidly growing Ontario Water Resources Commission. They include:

Dave Caverly, who later became OWRC General Manager;

Ken Sharpe, who rose to become Deputy Minister, Environment Ontario;

Fred Voege, who became General Manager, Environmental Assessment Board; and

Kim Shikaze who later moved to Environment Canada, Ontario Region, based in Toronto.

William Keay, former Director of Ottawa-Carleton's Pollution Control Division, is another engineer who gained prominence after completing a Federally-funded Master's degree.

"These are only a few of the many engineers who made a contribution to Ontario's pollution abatement projects, following Federal assistance," said Mr. Symons.

FEDERAL/ONTARIO

1982 Canada-Ontario Great Lakes Water Quality Agreement

On July 12, the 1982 Canada-Ontario Great Lakes Water Quality Agreement was signed between the Federal and Provincial governments. Formalizing their joint commitment to preserve and maintain and improve where necessary the quality of our boundary waters, the new Agreement reaffirmed the intentions of both Governments to continue and share in the cost of pollution control and surveillance programs on the Great Lakes.

The Federal Government and Ontario entered into their first co-operative agreement when they signed the 1971 Great Lakes Water Quality Agreement, In 1972, the Canada-United States Agreement on Great Lakes Water Quality was signed and then updated in 1978.

These two agreements included the pollution control and the surveillance monitoring efforts of 11 Federal, State, and Provincial governments to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem.

The main elements of these agreements were:

- Common objectives for water quality.

- The implementation of plans and schedules of agreed programs and measures to achieve the objectives.

- The assignment of powers and responsibilities to the International Joint Commission and its Boards to assist governments in implementing Agreements and overseeing the results.

The 1982 Canada-Ontario Agreement renewed existing obligations and reflected the 1978 Canada-United States Agreement by placing a greater emphasis on the control of toxic substances and pollution from diffuse sources, such as urban and agricultural runoff. It also provided for the continuation of Canada's cost-shared Great Lakes Surveillance Program, the continuation of the phosphorus-control program started in 1971, a one-time Federal grant of $65 million for municipal sewage works construction in the Great Lakes basin over the period 1982-1985, and co-operative efforts to identify and preserve significant wetland areas of the Great Lakes basin.

The key pollution-control aspects of the agreement were:

1. Municipal Sewage Treatment: The Agreement formalized arrangements made with the Federal Government in October 1981 to provide a one-time grant of $65 million over three years for sewage treatment projects in the Great Lakes Basin.

2. Industrial Waste Control: By December 1983, major Ontario industrial projects, already underway, had to comply with Agreement objectives for water-carried industrial wastes, including sources of hazardous and toxic substances, thermal and radioactive wastes.

3. Pollution from Land Use Activities: In accord with International Joint Commission recommendations of 1980, Canada and Ontario agreed to undertake measures for the control of pollution from pest control products and animal wastes, the handling and disposal of liquid and solid wastes, the control of soil losses, and the encouragement of efforts to improve land use.

   Continuation of the phosphorus-control program, started in 1971 and authorized under the 1972 Great Lakes Agreement, was re-authorized by the 1982 Agreement pending the completion of a further specific phosphorus-control agreement.

4. Pollution from Shipping: Measures for the control of pollution from commercial shipping and pleasure-craft were continued.

5. Pollution from Dredging Activities: Previous obligations to the control of pollution from dredging activities were continued, including the implementation of criteria developed by the Water Quality Board of the International Joint Commission.

6. Pollution from Offshore and Onshore Facilities: Existing obligations were renewed in the following areas:

   - Land transportation, including rail and road.
   - Pipelines on land and submerged under water.
   - Offshore drilling rigs and wells.
   - Storage facilities onshore and offshore.
   - Wharves and terminals with pipeway connections, to land and offshore structures, used for handling oil and hazardous polluting substances.

7. Control of Persistent Toxic Substances: Initiation of inventory, assessment, control and research programs for long-lived toxic substances found in water.

8. Surveillance: Canada would continue to share the cost of Ontario's Great Lakes Surveillance Program which, through surveillance and assessment of municipal and industrial waste discharges and effects of tributaries discharging to the boundary waters, determined trends in nearshore water quality and the effectiveness of remedial measures.

9. Research: Established under the Canada-Ontario Agreement, the Board of Review would assess research needs and reports annually and the undertaking of new projects, as required.

CANADA-ONTARIO EFFORTS ON NIAGARA RIVER POLLUTION

Ontario's Niagara River Program

In a separate but related activity, in the early 1980's, the Ontario Ministry of the Environment accelerated its abatement and containment measures to address one of our most pressing environmental priorities -- the Niagara River. Concern over the effects of metals and organic chemicals leaching from U.S. chemical waste sites has initiated extensive investigation, studies, and monitoring of suspected U.S. sources of contamination, such as the Love Canal and Hyde Park sites.

Through intervention in U.S. Government hearings and active participation in the U.S.-Canada Niagara River Toxics Committee, Ontario began pressing for abatement and containment of U.S. pollution sources as well as the continuing development of long-range hazardous contaminant control plans to protect the environmental integrity of the Niagara River, and in turn the Great Lakes.

The Ministry of the Environment established the Niagara River Improvement Team to spearhead its Niagara River programs. With the aid of independent geologic testing consultants, the Team co-ordinated Ontario's efforts to ensure action on both sides of the border to protect the water quality of the Niagara River. The Team also works co-operatively with such agencies as Environment Canada, the Department of Environmental Conservation in New York State (NYDEC), and the U.S. Environmental Protection Agency (USEPA). Major efforts were gaining momentum as this book went to press.

Environment Canada Niagara River Activities

Environment Canada, through its Environmental Protection Service and Inland Waters Directorate, and with the support of the Department of Fisheries and Oceans, continued comprehensive surveillance and scientific surveys of the water quality of the Niagara River and Lake Ontario. These efforts monitored the effectiveness of clean-up efforts of pollution sources to the Niagara River. A large research program on the fate and pathways of environmental contaminants at the mouth of the Niagara River was carried out in 1982-83 by the National Water Research Institute. In addition, Environment Canada continued to provide technical advice to citizens' groups who intervened in U.S. courts to press for clean-up efforts. Environment Canada continues to consult with Environment Ontario, USEPA and NYDEC on the implementation of remedial measures for the pollution of the river from U.S. sources.

CHAPTER NINE

THE EVOLUTION OF ENVIRONMENTAL ASSOCIATIONS

Public concern over ecological matters led to the formation of large numbers of anti-pollution associations in the early 1970's.

Some of these bodies were extremely active in drawing attention to environmental issues and applying political pressures. Some were short-term, single-issue pressure groups, created in response to specific problems. Others were altruistic and often technically ignorant. But other associations, like Pollution Probe, quickly emerged as forces to be reckoned with. Pollution Probe was born in 1968 at the University of Toronto after a group of students saw a private showing of a CBC program, "Air of Death". Led by Dr. Donald Chant, of the University of Toronto, Probe developed a cadre of skilled student researchers eager and willing to do exhaustive studies into particular environmental problems. Their impressive research was allied to a flair for presenting findings to the news media. But, generally, it is fair to say the Probers' energies are often directed at discovering and highlighting problems, rather than pursuing the applied science of providing solutions within practical economic and politically workable frameworks.

They enjoy the advantage that all critics enjoy; they can criticize from the comforts of the auditorium, without experiencing the labours of stage craft. The Probers did prove, however, that both governments and large corporations were vulnerable to well researched, expertly presented studies on environmental problems.

'Probe' later gave birth to Energy Probe. Both remain formidable groups on the environmental scene. Dr. Chant became Chairman and President of the Ontario Waste Management Corporation when the crown corporation was created on July 2, 1981, to establish and operate a liquid industrial and hazardous waste management system.

Ironically at the very time when the public developed an interest in environmental matters, two of the oldest associations serving this field appeared to be ignored by the public at large, in spite of their impressive record of public service. These associations, the Canadian affiliates of the American Water Works Association (AWWA) and the Water Pollution Control Federation (WPCF), were serving Canadians many decades before their youthful contemporaries. Two Canadian engineers, Dr. Berry and Norman McDonald, were closely involved with the WPCF when it began in 1928 as the Federation of Sewage Works Associations.

Over a century ago, the American Water Works Association (AWWA) attracted the interests of people involved in the purification and protection of drinking water supplies. When it celebrated its centenary in 1981 in St. Louis, Missouri, the AWWA could be justly proud of its role in having advanced the state of water purification technology while growing to be the largest, most prestigious association in the world in the drinking water field. Three Canadians from Ontario, have served as presidents of this illustrious body; Mr. Alex Milne, of St. Catharines, Dr. Albert Edward Berry, and Mr. Ross Dobbin, of Peterborough. Mr. Bill Hurst, of Winnipeg, was the fourth Canadian to be an AWWA President.

The first Canadian Section of the AWWA was established in Montreal in 1920 with Mr. Alex Milne of St. Catharines, Ontario, being elected its first chairman. Mr. Milne had previously distinguished himself in 1912 when he became the first Canadian elected to the Presidency of the AWWA in the U.S. This was a great honour for any non-American. The other distinguished engineer and scientist, Dr. A. E. Berry also brought honour to Canada in the wastewater treatment field. Dr. Berry, like Willis Chipman, cross-fertilized the disciplines of water purification with that of wastewater treatment. Already Secretary-Treasurer of the Canadian Section AWWA, Dr. Berry seized the initiative and developed interest in a pollution abatement institute at a time when public interest in such matters was less than enthusiastic. Slowly but surely a foundation of technical knowledge was built up which formed a solid research, engineering design and legislative base for today's environmental defences.

Historically, sewage treatment technology was not thought to be as advanced as the potable water treatment field covered by the AWWA. The idea of forming a sewage treatment Section of the AWWA was proposed and rejected at the 1927 AWWA conference in Chicago. However, prior to the rejection, the AWWA had held three conferences on sewage treatment. In 1928, a group of far-sighted North Americans formed the Federation of Sewage Works Associations which later became the Water Pollution Control Federation (WPCF). No annual conventions were held, initially, but the Federation launched the Sewage Works Journal. Equipment manufacturers promised to advertise in the new Journal and other support came from the patent revenues of Dr. Karl Imhoff, the German inventor of Imhoff tanks. This was several decades before the public showed any interest in pollution abatement. The publication has evolved into the present WPCF Journal, which is world-renowned for its environmental papers.

In 1932, Dr. Berry called a meeting which resulted in the formation of the Canadian Institute on Sewage and Sanitation (CISS) in 1933 with the first convention held at the King Edward Hotel in Toronto, October 18 and 19, 1934. This Institute later became affiliated with the U.S. based Federation of Sewage Works Associations. The first Institute Director of the Federation was Dr. A. E. Berry, who served from 1941 to 1943. Dr. Berry made history by becoming President of the WPCF in 1944-45, thus becoming the only man -- American or Canadian -- ever to have risen to become President of both the AWWA and the WPCF. Without question, these are the largest and most prestigious bodies in the world, serving the twin fields of potable water, and wastewater treatment.

For those who may be interested in the founding and early days of the WPCF, the publication "History of the Water Pollution Control Federation 1928-1977" available from the WPCF, makes fascinating reading.

The WPCF is a world-wide federation of water pollution control associations, while AWWA is solely a North American association. (The governing body of the WPCF is the Board of Control which is composed of the Federation President, the President-Elect, Vice President, Treasurer and immediate Past President. The Board also includes Directors from each member association. In order to manage the affairs of the WPCF between Board meetings an Executive Committee is appointed by the Board. In 1980, PCAO Director George Crawford served on this Committee under the, then, WPCF President Geoff Scott. In 1983, PCAO Director Charles Ferguson also served on this Committee under the then President,

Charles Jones. Also in 1983, PCAO member Peter Higgins was appointed a WPCF Director-At-Large.

The Federation has held its Annual Conference in Canada twice, both meetings being in Toronto. In 1946, there were a total of 812 registrants, including 202 ladies. An excerpt from the WPCF pollution "History of the Water Pollution Control Federation 1928-1977" makes note of the 1946 Toronto meeting:

> "When one begins to write about the 19th Annual Meeting of the Federation of Sewage Works Associations at Toronto on October 7-9, it is difficult to find sufficient superlatives to adequately express the proper appreciation and appraisal of this, the largest meeting of the Federation yet held.
>
> "While the official registration of 812 topped the previous high by an even 200, it is known that there were at least another two dozen or so persons who attended some phase of the convention but did not register. In addition to setting a new high registration at which future meetings must shoot, this meeting set many other unusual precedents of interest.
>
> "For one thing, the gracious hospitality of the Canadians and the Canadian Institute on Sewage and Sanitation as hosts is something to remember with delight. The experiment of beginning the convention on Monday (board meeting on Sunday) and ending on Wednesday seemed to meet with general approval. A chance to participate in the guided discussion type of operators' forum as it is carried on in Canada repaid many persons for the trip.
>
> "....the quietly efficient organization and operation of the mechanics of the convention (were) a tribute to the ubiquitous spark plug, Dr. A. E. Berry, Secretary of the Canadian Association."

What was at that time a record of 2,277 delegates attended the 1962 Federation conference at the Royal York Hotel in Toronto. Following the 1973 WPCF Conference in Cleveland, a re-convened session was held in Toronto. In 1983, the PCAO was successful in securing the 1991 WPCF Annual Conference for Toronto. This conference will be held in the newly-constructed Convention Centre. Past conference locations and presidents for The Canadian Institute on Sewage and Sanitation and the Canadian Institute on Pollution Control are as noted on Table 9-1.

In 1961 the name of the Canadian Institute on Sewage and Sanitation was changed to the Canadian Institute on Pollution Control, becoming a vital component in pollution abatement technology and research.

Although quite separate entities, the Canadian Section AWWA and the Canadian Institute on Pollution Control shared both office space and secretarial staff in Toronto through what was known as the **Water and Sanitation Secretariat**. Guided by Dr. Berry and ably administered for many years by **Mae Grove**, the same secretariat served in a most effective and professional manner.

In the 1960's rumblings began to be heard in Canada for a National Body comprising water, wastewater and possibly air pollution groups. Western

TABLE 9-1

The Canadian Institute on Sewage and Sanitation
The Canadian Institute on Pollution Control-Conferences and Presidents

YEAR	CONFERENCE LOCATION	PRESIDENT
1933-1934	Toronto	Roland C. Harris, Toronto
1934-1935	Toronto	William M. Veitch, London
1935-1936	Toronto	George H. Ferguson, Ottawa
1936-1937	London	Grant R. Jack, East York
1937-1938	Toronto	Norman J. Howard, Toronto
1938-1939	Hamilton	Warren C. Miller, St. Thomas
1939-1940	Toronto	William H. Riehl, Stratford
1940-1941	Kitchener	Stanley Shupe, Kitchener
1941-1942	Toronto	W. Lawrence McFaul, Hamilton
1942-1943	Niagara Falls	Benjamin F. Lamson, St. Catharines
1943-1944	Toronto	Roy H. Parsons, Peterborough
1944-1945	Windsor	Ray J. Desmarais, Windsor
1945-1946	Toronto	Harold S. Nicklin, Guelph
1946-1947	Niagara Falls	Nicol MacNicol, Forest Hill
1947-1948	Ottawa	G. Harry Richards, Brantford
1948-1949	Schumacher	Tom M. S. Kingston, Chatham
1949-1950	Lake of Bays	Leonard G. McNiece, Orillia
1950-1951	Toronto	D. A. Roy McCannell, Regina
1951-1952	Montebello	Clarence S. Anderson, Toronto
1952-1953	Niagara Falls	Gordon H. Baker, North York
1953-1954	Montreal	A. Edward Chalmers, Peterborough
1954-1955	Schumacher	Nathan S. Bubbis, Winnipeg
1955-1956	Windsor	C. G. Russell Armstrong, Winnipeg
1956-1957	Toronto	Leslie B. Allan, Toronto
1957-1958	Quebec	Roderick V. Anderson, Toronto
1958-1959	Toronto	James F. MacLaren, Toronto
1959-1960	Niagara Falls	W. Leslie Wardrop, Winnipeg
1960-1961	Montreal	Ross L. Clark, Toronto
1961-1962	Toronto	Fred M. Woods, Guelph
1962-1963	Quebec	George M. Galimbert, Toronto
1963-1964	Niagara Falls	Douglas F. McCarthy, Toronto
1964-1965	Ottawa	Frank E. Ayers, Ottawa
1965-1966	Windsor	William M. Swann, Etobicoke
1966-1967	Toronto	Alexander Penman, Winnipeg
1967-1968	Hamilton	Robert T. Bailey, Windsor
1968-1969	Montreal	David S. Caverly, Toronto
1969-1970	Calgary	James G. Hooper, Peterborough
1970-1971*	Toronto	Fred M. Woods, Guelph

* CIPC Ontario Branch

Canada, the Maritimes and Quebec appeared initially to be major proponents of such a body. The Canadian Section AWWA and the CIPC were not so enthusiastic.

Events in Quebec dramatically altered the picture. In 1962, the Association Quebecoise des Techniques de l'Eau (AQTE) burst on the scene. AQTE combined both the pure water and waste treatment disciplines. But it also went an important step further. AQTE, in effect, attained AWWA Section status and gained the right to have its own Director on the AWWA Board in the United States.

Pat Bourgeois, an energetic founder member of AQTE became Section Director, holding equal status with other AWWA Section Directors. This fait accompli now meant that there was a director representing the Canadian Section and a director representing the Quebec Section. Obviously, the Canadian Section AWWA was no longer representative of the whole of Canada (Pat Bourgeois, respected from coast to coast for his brilliant oratorical skills and deep environmental concerns, died suddenly at an AQTE Congress, immediately after receiving AQTE's first honorary Presidency in Quebec City in 1982. Pat studied at Queen's University with many Ontario engineers who later distinguished themselves as environmental engineers).

Fuelled by the Quebec move, interest in a new national body increased. People were vague about the actual structure, or form, of a new association but enthusiasm grew in all areas of Canada. Provisionally called the Canadian Council on Environmental Resources (CCER), the proposed National Body would be designed to combine activities in all disciplines affecting environmental resources.

Soon suggestions were being made to form five regional AWWA Sections, in the Maritimes, Quebec, Ontario, the Prairies and B.C. Indeed, the Canadian Section of AWWA produced a white paper in May 1970, proposing a format for a Canadian National Water Works Association, comprised of five Sections. (The later Federation of Associations on the Canadian Environment bears a strong resemblance to this initial proposal, but, of course, also includes wastewater bodies.) The Canadian Section had some structural difficulties to overcome. An AWWA Section differs from a WPCF member association in that each AWWA member joins AWWA and is placed in the appropriate geographical Section by the U.S.A. office. WPCF member associations, such as the Pollution Control Association of Ontario, are autonomous associations which join the Federation at their own volition. When the AWWA Board allowed a Section in Quebec, it was over the objection of the Canadian Section Director. The Canadian Section had to resolve the issue with AWWA as to whether, or how, appropriate funds could be released to the new Quebec Section or any other Sections formed in Canada.

When the AWWA gave its blessing to the Canadian Section's plans for dissolution and appropriation of funds to the new Sections forming in Canada, the way was then clear for the Canadian Section to begin alignment in a national body. After a member ballot, the Canadian Section funds were available for distribution, on a member population basis, to the proposed five Sections. The last of the funds distributed were to the B.C. Section. This Section had a north-south alliance with Washington State, which alliance had to be resolved before the B.C. Section was established. During this transitional era, the Canadian Section had proponents of a national body comprising water and sewage

interests, and also those who favoured a national water works body only. In preparation for some change, the Canadian Section fostered an Ontario Branch which later became the Ontario Section.

At the 1968 annual CIPC convention, members unanimously endorsed CCER proposals. Dave Caverly, then OWRC General Manager and CIPC president, explained that, when the National Body became a reality, it would mean the end of the CIPC which would become fully absorbed. The Institute welcomed the idea of absorption and were happy at the idea of a multi-disciplinary approach for the future. In short, the CIPC was happy to dissolve, then re-emerge into a form amenable to the new National Body structure.

In 1969, the Canadian Institute on Pollution Control briefly formed an Ontario Branch and later dissolved. Its assets were distributed on a per capita basis across Canada. The Pollution Control Association of Ontario (PCAO) was born from the Ontario Branch in 1971 as a direct linear descendant of the Canadian Institute on Pollution Control, under the Presidency of Fred Woods, later City Administrator of Guelph, Ontario, and now retired. Geoff Scott, later to rise to become the second Canadian to attain the Presidency at the WPCF, was the first PCAO Secretary-Treasurer. The PCAO became the largest, single, professional pollution abatement group in Canada with some 750 members.

The Ontario Section of the Air Pollution Control Association (APCA) expressed interest in joining the Canadian Council on Environmental Resources and, for a while, the National Body concept became a topic of some enthusiasm. Some 15 years later, however, APCA remains outside the national framework but the Ontario Section, APCA, now holds annual joint conferences with the PCAO. At the time of writing, seven joint PCAO/APCA conferences have been held. The first joint conference was held in 1978 at the Prince Hotel in Toronto.

Meanwhile the Maritime provinces formed a Branch of the Canadian Section AWWA. Later this evolved into the Atlantic Canada Section, AWWA. At the time of writing no major pollution control body has been set up in the Maritimes. People there who wish to join the WPCF must join through AQTE, the PCAO, or other regional WPCF affiliates (however, the Water Pollution Control Federation made tangible moves to set up an Atlantic WPCF member association at the AWWA/FACE meeting, September 13-16, 1981 in Moncton, New Brunswick).

Similarly, the Canadian Section AWWA, at its convention in April 1970, recognized the inevitability of a national water and wastewater body, and of the desire and need for area Sections. Thus, on its 50th anniversary the Canadian Section initiated the next progressive step of water works associations in Canada.

The Canadian Section then dissolved and re-emerged as five regional AWWA Sections, the largest being the Ontario Section.

Concurrently FACE, (a bilingual acronym for Federation of Associations on the Canadian Environment) was born in 1971 after a gestation period of several years. This was the National Body, originally designated the Canadian Council on Environmental Resources. After years of talking, FACE, like so many Canadian institutions, was something of a compromise.

The Constituent Members of FACE are:
Atlantic Canada Section AWWA,
Association Quebecoise des Techniques de l'Eau,
British Columbia Water and Waste Association,
Ontario Section AWWA,
Pollution Control Association of Ontario,
Western Canada Water and Sewage Conference.

FACE does not itself have even a single member. It survives by a levy of $2 per annum, per member, on all its constituent member associations. In one sense FACE has already shown it can be a unifying force. It repeatedly attracts dedicated officers across Canada. But in both the potable water and wastewater associations, Ontario has thus far not matched the enthusiasm for FACE which has been generated in other parts of Canada. It must be noted however, that Arthur Doran, Ontario's first FACE President, and other FACE Directors from the Province, such as the PCAO's John Reid, invariably become imbued with enthusiasm for the National Body after serving on the board.

The 1980-81 FACE President, R. A. Goodings of Toronto was a member of both the AWWA and the PCAO. Through his efforts, and those of luminaries such as Quebec's Pat Bourgeois, and BC's Stan Mason, FACE began to realize its early potential as a truly National Body during the early 1980's. On October 14, 1981, in Moncton, New Brunswick, John Roberts, then Federal Minister of the Environment, told the AWWA/FACE meeting that the Federal Government strongly supported FACE. He said FACE was the leading National Body involved in the fields of water supply and pollution control. The Minister said: "The work of this group is extremely important and my department has been pleased to support the organization since its inception." Such a ringing endorsement from the Federal Government was a great encouragement to those environmentalists across Canada who had laboured so long to make FACE a viable national body.

The day after the Minister had endorsed FACE so positively, Bob Goodings transferred the FACE Presidential Chain of Office to Eric Mercer of Newfoundland. During Mr. Goodings' term of office, FACE had palpably strengthened its position on the Canadian environmental scene. The Minister's endorsement of FACE was a final accolade in Mr. Goodings' presidential term. However, in 1984, while FACE had made great strides, it had still not achieved the cohesiveness envisaged by its founding fathers. The Federation's future will be more rigorously defined during 1985 when it is the PCAO's turn to host the annual multi-regional, multi-disciplinary FACE conference.

An examination of the records shows that Ontarians repeatedly gave dedicated service to many of the professional associations concerned with environmental protection, many achieving distinctions, or holding high office.

Only two Canadians were ever elected President of the Water Pollution Control Federation. Both are Ontarians and their personal backgrounds are extremely interesting.

Two Canadian Presidents of the WPCF, Dr. Berry and Geoff Scott

In 1894, on October 6th, in a farmhouse set amid the rich rolling countryside outside St. Marys, **Albert Edward Berry** was born. It was to

become an event of great significance to Canadian environmental engineering in general and to Ontario in particular. Albert was one of nine children, and even though farming was hard in those days, the Berry's were comfortably off. When Albert first walked to the red brick school before the turn of the century, few realized that they were seeing the first steps in a brilliant academic career which would make him internationally renowned as an environmental engineer and scientist.

When he was young, water treatment plants, even simple chlorination, hardly existed in Ontario. In his autumn years, he could look back with pride on a Province where 98 percent of the population had drinking water treatment facilities, with sewerage and sewage treatment facilities available for 94 percent. This record is equalled by few jurisdictions abroad and unmatched in Canada. But none of this could be foreseen as the child entered public school as a toddler.

His formidable intellect quickly asserted itself and his teachers channelled his efforts towards university, a rarity for farmers' sons in those days. At university there was no doubt of his brilliance and he gained a B.A.Sc. from the University of Toronto in 1917. He worked briefly for the Ontario Board of Health, then went to England as a 2nd Lieutenant in the Royal Engineers during World War I.

Britain was then a pioneer in sanitary engineering and the young Lieutenant Berry found much to intrigue him. This was the country of Ardern, Lockett and Fowler, whose discovery of the activated sludge process still remains the single most important discovery in wastewater treatment. Dr. Berry met Ardern and was no doubt influenced by him.

Following his wartime service he returned to what was to become the Ontario Department of Health and took a Master's Degree with a thesis on refuse collection and disposal. The subject of his thesis, written 60 years ago, is one of our most urgent contemporary problems. But then, Albert Edward Berry always was decades ahead of his time.

After deciding to take a Ph.D at the U of T's School of Hygiene, he encountered difficulties. Engineers were not supposed to cross disciplinary lines and obstacles were placed in his way. But the University was dealing with a very determined man. Not for the first time, he got his way and eventually gained his Ph.D, with a thesis on the viability of pathogenic organisms in milk.

This thesis was to have far-reaching effects in Ontario, for later Dr. Berry was instrumental in getting the Provincial Legislature to make milk pasteurization compulsory. Not only was this legislation the first of its kind in Canada, but internationally, the move was regarded as precedent-setting.

In 1926, Dr. Berry was appointed Director of the Ontario Department of Health's Division of Sanitary Engineering. He recalls investigating a number of epidemics including TB, para-Typhoid, and Typhoid. Some resulted from milk; others were water-borne diseases. Much of his work involved checking chlorination dosages for water supplies, decades before the formation of the Ontario Water Resources Commission.

In those days, the Health Department had 'mandatory order' authority to compel municipalities to chlorinate, or install water filtration plants. Some of these orders were strenuously opposed by municipalities. In one

instance, the entire council resigned, rather than obey the order. When the council was replaced, the new councillors again resigned, en masse. But they were fighting a man who was to become renowned for his obduracy and the order was eventually obeyed.

Dr. Berry's tenacity and skill at transforming scientific desirabilities into legislative realities did not go unnoticed at Queen's Park. People in high places began to take notice of the young Dr. Berry who was thinking of radical changes in water resource management.

The concept of the Ontario Water Resources Commission emerged during a lunchbreak, when the talk centred around the need for water resources management. As a result of this informal chat, Dr. Berry prepared a memorandum which was presented to the Ontario Cabinet. Later a call came from Premier Leslie Frost who had been contemplating such a commission, following a meeting with President Eisenhower. The result is history. Dr. Berry was appointed General Manager and Chief Engineer of the Ontario Water Resources Commission (OWRC) in 1956. From a handful of people, it quickly grew to be an internationally renowned agency, developing a legislative base to match the excellent research facilities.

Dr. Berry has been criticized for being reluctant to delegate. He was deeply involved in design approvals, draft regulations, and research projects, which, along with the enormous administrative and political pressures, not to mention his role in various associations, presented a burden which would have crushed lesser men.

He was particularly proud of the OWRC, (now Ministry of the Environment) Laboratories on Resources Road, Toronto. "I told Mr. Frost, the Premier, we needed such a laboratory and he said 'go ahead'," he said. It was that simple in those days.

Dr. Berry would show rare flashes of anger at those who accused Ontario of neglect over the newly revealed dangers of certain highly toxic materials. In many instances, no one could have foreseen the dangers of some chemicals, he stressed, and it was so easy to be wise after the event. He noted, too, that many people who were unenthusiastic about funding research facilities became very vocal when problems emerged.

While he was building up the OWRC from scratch to a world renowned body, he also found time to devote considerable energies to professional associations. During his career, the honours flowed in over the years.

Officially, retirement came in 1963 and he became a consultant to the World Health Organization, working on projects in South East Asia.

Even in retirement, the honours still flowed in. In 1973, the nation recognized his myriad achievements when he became a member of the Order of Canada. The University of Toronto awarded him the Engineering Alumni Medal the same year, followed by induction into the Engineering Alumni Hall of Distinction in 1977.

A widower for many years, Dr. Berry was a man who had everything - except children, an irony for one whose work most certainly saved the lives of thousands of infants in the days of frequent epidemics.

A visit to his home in St. Marys revealed many unusual facets to this amazing man. The grandfather clock which chimed intermittently was assembled by him. Examination of some of the household artifacts revealed that he was also a skilled wood carver.

Perhaps the biggest surprise, however, was that he was an artist of unquestioned merit. Coming from a man who exercised strong, vigorous leadership all of his working life, one might have expected bold strokes and vivid colours to be a characteristic of his paintings. But no, the canvasses combined unexpected subtlety in colour and draftsmanship.

Reading back issues of the Canadian Institute on Pollution Control Newsletter, which he edited for many years, reveals a further artistic dimension. The brightly written newsletters were always sprinkled liberally with quotes from great poets and authors. The publication interwove science, poetical quotes and technological information with a style and lucidity few contemporary newsletters could match. This really was an engineering man for all seasons.

One must, it seems, never be surprised at the many talents of Albert Edward Berry, O.C., Ph.D., P.Eng., Ontario's pioneer Environmentalist.

On June 13, 1979, Dr. Berry received yet another honour from his Alma Mater, the University of Toronto. The Dean of the Faculty of Applied Science and Engineering, B. Etkin read the following citation:

> "Mister Chancellor. Albert Edward Berry is one of Canada's greatest engineers, and one of this University's most distinguished alumni. In an age when concern for the environment is pervasive, when institutes that study it, citizens' groups that probe it, and programs that teach about it, proliferate all over the western world, most are simply "Johnnies-come-lately" when compared to Albert Berry. Since 62 years ago when he graduated in civil engineering from this University in 1917, the cleanliness of Ontario's lakes and rivers, and the purity of our drinking water, have been his prime professional concern.
>
> During all that period, he has been the towering influence that paved the way to new developments, both technological and political, that have made this Province a beacon in the field of water resources management - without question the leading jurisdiction in Canada, and possibly in North America. His success required a balanced triumvirate of talents - engineering, management, and political. As an engineer he perceived the physical nature of the problems of water pollution and of their solutions; as a manager he was able to weld the human, financial, and physical resources at his disposal into effective instruments of action; and his consummate political skills, coupled with his unquestioned credibility and integrity of character enabled him to accomplish all this in the public domain as a civil servant. From 1917 to his retirement in 1963 he was in the service of The Ontario Government, first in the Department of Health, and latterly as the General Manager and Chief Engineer of the Ontario Water Resources Commission, an entity of which he was the architect.
>
> Dr. Berry was a teacher as well as a practitioner. After receiving the first Ph.D. in Civil Engineering from U. of T., he taught in both the School of Hygiene and the Department of Civil Engineering

as a special lecturer and associate professor for a total of 37 years. Through his teaching he almost single-handedly created the sanitary engineering profession in Ontario.

Mister Chancellor, time prevents me from even beginning to enumerate Dr. Berry's many specific accomplishments and honours. Let me just note that his stature is such that he has been awarded the Order of Canada, that he has served on many national and international bodies, for example advising the World Health Organization on water and sewage facilities in several third-world countries, serving the Canada/U.S. International Joint Commission on Boundary Waters, and that he is the only person to have served as President of both the American Water Works Association and the Water Pollution Control Federation.

Aside from his professional accomplishments, Dr. Berry is known to his intimates as a man of many hobbies, including painting, wood-carving and leather work, in which his skills are much admired.

Mister Chancellor, it is with the greatest of pleasure that I present to you a distinguished graduate of this University and of my Faculty, Dr. Albert Edward Berry, that you may confer upon him the Degree of Doctor of Engineering, (Honoris Causa)."

Space does not permit a full listing of his honours and distinctions, but the few listed here give some idea of the range and scope of this versatile engineer and scientist.

American Water Works Association

1938 - Fuller Award
1949 - Goodell Prize

Water Pollution Control Federation

1944 - Kenneth Allen Award
1959 - Charles Alvin Emerson Medal
1966 - Bedell Award
1981 - Gordon Maskew Fair Medal

Canadian Institute on Pollution Control

1965 - James F. MacLaren Award for achievement in pollution control

Other Distinctions

1965 - The Golden Wrench, Ontario Association of Plumbing Inspectors
1967 - Julian Crandall Conservation Trophy
1968 - Ambassador Award, American Water Works Association
1969 - 1975 - Honorary President, Ontario Municipal Water Association
1971 - Professional Engineers Gold Medal - A.P.E.O. for outstanding achievement
1971 - Dr. Albert E. Berry Waterworks Award - a scholarship established at the University of Toronto by Canadian Section, AWWA.

1972 - Recognized as a Founding Member of the Association of Professional Engineers of Ontario at 50th Annual Meeting.
1973 - Order of Canada
1973 - University of Toronto Engineering Alumni Medal
1977 - University of Toronto, recognition for long and distinguished Service to University - during sesquicentennial year
1977 - Applied Science and Engineering congratulations on 60 years as a member of engineering profession et al.
1977 - Medal - the Queen on 25th anniversary of accession to the Throne
1977 - Induction into the University of Toronto's Engineering alumni Hall of Distinction.

Dr. Berry was also a member of the WPCF's Select Society of Sanitary Sludge Shovellers. In spite of its humorous designation, the miniature gold-plated shovel is worn as a badge of honour.

As Dr. Berry approached his 90th birthday he was nominated for the AWWA Hall of Fame.

This then was Dr. Albert Edward Berry, a man who, even in his late eighties, could evoke such admiration and accolades from distinguished academic and international bodies. On October 19, 1984, Dr. Berry died in Stratford, Ontario. Many distinguished engineers joined the family at the funeral in St. Marys to pay homage to Canada's pioneer environmentalist.

Geoff Scott

The glamour and glitter of Las Vegas, Nevada seems an unlikely venue to be a place of significance to Ontario's environmental community. Ontario, the only Canadian province fronting the Great Lakes, has tens of thousands of lakes which offer a dramatic contrast to the meagre rainfall and aridity of the Nevada Desert.

But it was at Las Vegas in 1980 that Geoffrey T. G. Scott, P. Eng. of Aurora, Ontario, concluded his term as President of the Water Pollution Control Federation.

A report in Water and Pollution Control's 1980 Environmental Handbook and Directory outlined the significance of the occasion while summing up his term of office:

> "The Water Pollution Control Federation's 53rd Annual Conference had a special significance for Canadians as it concluded in Las Vegas, Nevada. The meeting -- marked the end of Geoff Scott's term as WPCF President, and, not since Dr. A. E. Berry has a Canadian held this high executive post.
>
> "The President of the Federation is more than a mere figure head. The position entails a gruelling 12 months of constant travel, exhaustive committee work, representations to government agencies, interfacing with other associations and a back-breaking load of administrative work.

"While a highly-professional executive staff in Washington relieves some burdens, the sheer complexities involved in contemporary environmental affairs make the president's task a difficult one. Federation presidents must rule, as well as reign. In addition to tough negotiations with bodies such as the EPA and other government agencies, there are endless visits to WPCF member associations throughout the world.

"Few would deny that Geoff Scott, P. Eng., handled the presidential role with wide-ranging understanding of the problems, along with a surprising sense of humour. Whether in Vancouver, Texas or Montreal, he always had an effective aside to meet each occasion.

"His presidential term, which reflected well on all Canadians, was the apex of a career in environmental engineering."

Geoff Scott was born within the sound of Bow Bells in London, England, thus qualifying him as a bona fide cockney. Geoff studied civil engineering at the City and Guilds College, London University, graduating with a B.Sc.(Eng.) and as an Associate, City and Guilds Institute (ACGI). Later he served as a Lieutenant in the Royal Engineers, seeing service in East Africa and India. It is worthy of note that both Canadian WPCF Presidents were Lieutenants in the Army and both were stationed for a period of their service at Bowbridge Camp in Newark, Lincolnshire.

Geoff resumed his studies after his war service, gaining a Diploma of Imperial College, London. Initially, he was employed by the British consulting engineering firm of Sandford Fawcett and Partners. This firm later sent him to help establish the newly formed firm of Canadian-British Engineering Consultants. England's loss became Canada's gain.

Geoff rose to become President of Canadian-British Engineering Consultants (1971) Limited and Chairman of the Board of the Canadian-British Consulting Group. He resigned as President in 1976 and currently practises as a consulting engineer in environmental engineering.

Geoff was a tireless worker for the PCAO in various roles, including its first Secretary-Treasurer when the Association was created out of the Canadian Institute on Pollution Control. Geoff remembers vividly the first meeting of a committee, chaired by Fred Woods, which was formed to examine the establishment of an Ontario Chapter or Section of the Canadian Institute on Pollution Control (later to become PCAO).

"I was invited to sit on that Committee as a representative of the Ontario Chapter, ACEC. The meeting was held in the OWRC Boardroom. Whether I was the nearest person to Fred Woods, or the only member with a pad and pencil in front of me, is unclear in my memory. However, Fred did ask me to act as secretary. Little did I dream that such an innocent request would lead to an ongoing participation in PCAO affairs and an experience with the WPCF which so few have been priviliged to enjoy."

In 1975, Geoff received the Bedell Award from the WPCF and a year later was elected a Diplomate of the American Academy of Environmental Engineers.

Geoff lives in Aurora, 25 miles north of Toronto, with his wife, Gail and their two small sons. In summer, he relishes the challenge of gardening on his two-acre lot, and, in the winter, he spends hours on his huge model railway system. He is very accomplished in woodworking and other artisan skills, his large basement being furnished and decorated in a highly professional manner shortly after he moved into his country house. Like his illustrious counterpart, Dr. Berry, Geoffrey Thomas George Scott is a man of many talents.

Canadian Society for Civil Engineering - Toronto Section

For almost two decades the Environmental Division of the Canadian Society for Civil Engineering has held highly successful dinner evenings. The meetings foster a spirit of camaraderie among the professional engineering environmentalists while doing much to advance the state-of-the-art.

The recipe is simple. Get a great venue, often Hart House at the University of Toronto, add a top notch speaker and choose the banquet menu carefully. The result has been years of highly convivial evenings where engineering peer groups mingled over dinner and drinks; then a speaker, or panel, focussed on technical engineering problems or environmental situations.

The 15th anniversary was marked November 27, 1979, when Sid Dutton of Proctor & Redfern Limited regaled engineering peers with a witty recapitulation of the past, giving full credit to Jim MacLaren for providing the thrust which had made the events a reality.

The evening was followed by a presentation of plaques to mark the occasion. Steve Black, Ontario Ministry of the Environment, was 1979-81 chairman of the CSCE Environmental Division. He recalls that the Division actually began on December 8, 1964, when a group of six practising engineers from Toronto met at the Granite Club. It was the first organizational meeting of a new section of the Toronto Branch of the Engineering Institute of Canada, being the brainchild of Jim MacLaren and Sid Dutton. Mr. Black feels that the Water Works and Waste Disposal Section became a significant vehicle for the transfer of sanitary engineering technology in the greater Toronto area.

Although established as a technical engineering organization, the Section meetings soon became a social gathering forum for all disciplines in the pollution control field.

The first technical meeting of this new Section was held at the Faculty Club, University of Toronto, on February 9, 1965, and consisted of a dinner followed by a panel discussion on "Effluent Standards and Stream Classification".

Since then, the Water Works and Waste Disposal Section has traditionally held three or four dinner meetings per year, and have included plant tours in its annual program. At least one technical meeting per year is jointly organized with the Pollution Control Association of Ontario.

Although primarily drawing upon local talent as speakers for its meetings, attempts are made to occasionally include nationally and internationally renowned professionals. Such leaders in the field have included W. W. Eckenfelder, R. E. McKinney, D. J. O'Connor, C. N. Sawyer and Dr. A. E. Berry.

Field trips have been made to the Toronto Island Water Filtration Plant, the Ontario Centre for Resource Recovery, Tricil's Liquid Waste Incinerator, the Duffin Creek Water Pollution Control Plant and Molson Brewery's Deep Shaft Wastewater Treatment System.

In 1976, it was decided that the name Water Works and Waste Disposal Section was somewhat outdated and provided a narrow connotation to the Section's interests. The same civil engineers whose sole professional activities during the early 60's centred around water and wastewater treatment had by then become involved in new areas such as solid waste management, environmental impact and assessment activities, air pollution control, and water resources management. Accordingly, the name was changed to "The Environmental Engineering Division".

In 1977, the Environmental Engineering Division became involved with the Metro Toronto Science Fair. Continuing annual activities in this regard include guidance and counselling to Toronto high school students in career planning, summer employment in member companies to a select number of outstanding students, and a cash contribution of $200 to the Fair.

The Division continues with its highly relevant contribution to the state-of-the-art by focussing on contemporary environmental issues. Recent speakers and panels have dealt with equipment purchasing, disposal of nuclear wastes and how engineering proposals are affected by citizens' pressure groups.

Initial Executive Membership

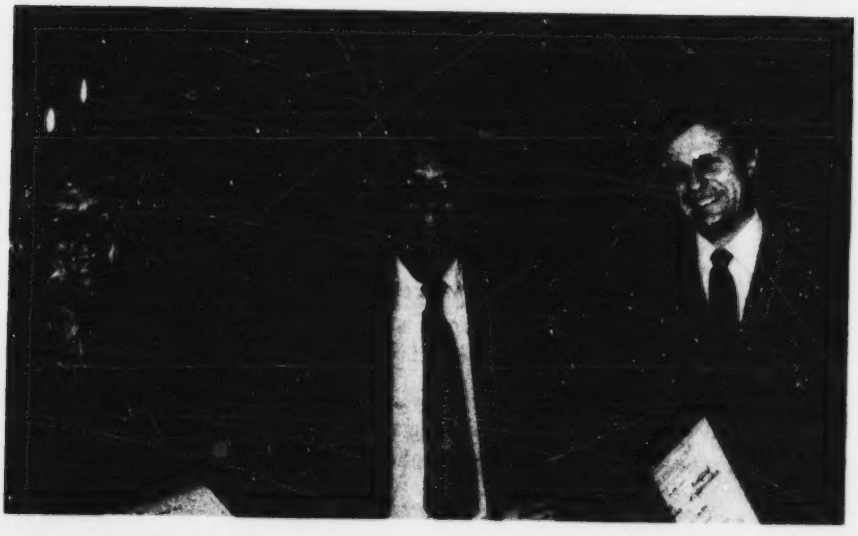
J. MacLaren	- Chairman
S. Dutton	- Vice-Chairman
D. Greenfield	- Secretary-Treasurer
R. Simmons	- Member
D. Caverly	- Member
N. Pappas	- Member

Past Chairmen

S. Dutton	1964-65
N. Pappas	1965-66
J. Thon	1966-67
E. Fox	1967-69
H. Fielding	1969-70
I. Harvie	1970-71
G. Sigal	1971-72
R. Cameron	1972-73
P. Laughton	1973-74
L. Atkinson	1974-75
P. Lord	1975-76
O. Martini	1976-78
C. Williams	1978-79

Canadian Society for Civil Engineering Awards Night
November 27, 1979 Cricket Club Toronto

Left to right, top row standing: Lorne Atkinson, Hugh Fielding, Gerry Sigal, Peter Laughton, Sid Dutton, Dave Greenfield, Ian Harvie. Second row kneeling left to right: Ed Fox, Orlando Martini, Clive Williams.



Left to right: Sid Dutton, Hugh Fielding and Peter Laughton enjoying a lighter moment during the evening.

S. A. Black	1979-81
G. Sigal	1982
R. Baker	1983-84

Awards Associated with Environmental Activities

The ARTHUR S. BEDELL AWARD is given for outstanding service in the sewerage and wastewater treatment works field, as related particularly to the problems and activities of WPCF Member Associations.

This award was made until 1949 under the name of the KENNETH ALLEN AWARD.

The WILLIAM D. HATFIELD AWARD is given to recognize operators of wastewater treatment plants whose performance has been outstanding and who have demonstrated distinguished professionalism.

Previous Awardees Through the Canadian Institute on Pollution Control

	Kenneth Allen Award	
1944	Albert E. Berry	
1947	William Storrie	
	Bedell Award	**Hatfield Award**
1950	Theodore J. Lafreniere	*
1953	Douglas L. MacLean	*
1956	Ray J. Desmarais	*
1957	Gordon H. Baker	Douglas J. Davidson
1958	Clarence S. Anderson	Charles Hicks
1959	William L. McFaul	-
1960	Antoine V. Delaporte	William Hardy
1961	James F. MacLaren	Leslie W. Sharman
1962	George Morgan	William Thompson
1963	Norman G. McDonald	Drew Fowler
1964	C.G. Russell Armstrong	Willett C. Cross
1965	Tom M.S. Kingston	Roger Beaudet
1966	Albert E. Berry	John A. McNamara
1967	J. Frankland Bolton	Kenneth R. Stratton
1968	Ross L. Clark	Laurence A. Snell
1969	Harvey Hogge	Samuel Kozack
1970	Mae Grove	John Breckenridge
1971	Jean-Paul Gourdeau	Charles Fiddy

* Established 1957

Previous Awardees Through the Pollution Control Association of Ontario

	Bedell Award	Hatfield Award
1972	David Caverly	Alan Robson
1973	John Argo	George Buckley
1974	Percy Williams	John Cook
1975	Geoff Scott	Jim Telfer
1976	Sidney Dutton	Robert Payne
1977	Frank Avers	Clifford Biggin
1978	James Hooper	James Williams

1979	Dennis Caplice	Edward Nevala
1980	John Reid	Wadid Salib
1981	George Crawford	Neil Gross
1982	Jack Norman	Earl Hay
1983	Gerry Crossman	Jim Clarke
1984	John Patterson	Ronald Gemmell

THE FACE NATIONAL ENVIRONMENTAL AWARD was presented, in 1979, to **David Caverly**. The FACE Award is given to recognize, on a national basis, a person or organization which has achieved distinction in the field of environmental activity. Mr. Caverly joined the Ontario Department of Health in 1949. In 1957, he was transferred to the newly-formed Ontario Water Resources Commission. One year later, he was appointed Director of the Division of Plant Operations. In 1963, he became General Manager of the OWRC, a position he held until the Ministry of the Environment was formed in 1972. He was then appointed Assistant Deputy Minister in charge of Water Management. In October, 1973, Mr. Caverly entered into a new and important phase of environmental responsibility, with his appointment as Chairman of the Environmental Hearing Board and, later, the Environmental Assessment Board. He was also associated with the work of the International Joint Commission, being for many years a member of the Great Lakes Water Quality Board.

The HARRY E. SCHLENZ MEDAL was awarded in 1980 at Las Vegas, Nevada to **Tom Davey** for distinguished service in promoting public awareness, understanding, and action in water pollution control. A WPCF Committee examined his environmental articles, many of which were investigative features, revealing serious problems. Among the articles examined were a satirical series warning of mutagenic dangers of aerially sprayed herbicides, which, in 1970, won him Canada's first J. H. Neal Award from the American Business Press in New York.

In 1984, Mr. Davey received a national award from the Federation of Associations on the Canadian Environment for interpreting complex environmental situations. (The year before John Roberts won the first such FACE Award for his efforts to reduce acid rain while federal environment minister.) A year earlier he had been again honoured by the American Business Press in New York when he won J. H. Neal Award of Merit for an environmental satire. Neal Awards are called the Pulitzers of the American Business Press.

In addition to his international honours, he has won six National Awards in Canada for his writing and eleven Southam Awards.

In 1981, the WPCF's GORDON MASKEW FAIR MEDAL was awarded to **Dr. Albert Berry** to recognize his worthy accomplishments in the training and development of future engineers. His other awards are listed in more detail in the section on Dr. Berry.

The 1982 WILLEM RUDOLFS MEDAL was awarded to a group including PCAO member **David Averill** for the most outstanding contribution on any aspect of industrial wastes control, as published in the WPCF Journal.

In 1983, the American Institute of Chemical Engineers awarded the LARRY K. CECIL Environmental Division Award in Chemical Engineering, to **Dr. Andrew Benedek**, President of Zenon Environmental Inc., Burlington, Ontario. The award recognizes and encourages individual outstanding chemical engineering contributions toward the preservation and/or

improvement of man's natural environment. Dr. Benedek received the award for his contributions in developing improved analytical methods and novel water and wastewater treatment processes.

In June, 1984, **Michael Keating**, a reporter from the Globe & Mail, was honoured by the United Nations for the excellence of his environmental writing. He was the only print media journalist to be honoured among the internationally-renowned awardees. Mr. Keating has frequently attended PCAO events and his coverage is well respected.

Each year the Pollution Control Association of Ontario recognizes the contributions of its members in the water pollution control field. Recipients of the various awards are as follows:

Chairman - Annual Conference

1971-73	Sidney Dutton
1974	Gerald Crossman
1975	Paul Emery
1976	Sydney Love
1977	George Powell
1978	Terry Fahlenbock
1979	Stephen Black
1980	Donald Hoskins
1981	Ervan McIntyre
1982	Don Gillies
1983	Doug McTavish
1984	Harry McAdie

Chairman - Seminar Committee

1972-75	Grant Mills
1976	Ted Kruk
1977	Peter Laughton
1978	John Carnduff
1979	Igor Marvan
1980	Gerald Rupke
1981	Robert Booth
1982	Bruce Halbert
1983	Frank Iliffe
1984	Bob Baker

Chairman - Student Affairs Committee

1977-78	George Crawford
1978-80	Roy Fletcher

Member - Executive Committee

1970-71	Kenneth Comyns
1970-72	Percy Williams
1970-73	Roy Edwards
1971-74	Allan Jackson
1972-75	Harvey Clare
1974-76	Arthur Doran
1976-79	Lloyd Larson
1978-80	James McCoubrey
1978-81	Glynn Henry

1979-82	Mel Holenski
1982-83	Murray Greenfield
1983-84	Gerry Rupke

The SELECT SOCIETY OF SANITARY SLUDGE SHOVELLERS is awarded by the local chapter for "outstanding meritorious service above and beyond the call of duty." A local Chapter was formed in 1983, with the first presentations made at the Joint PCAO/APCA annual conference in London. Recipients include:

Select Society of Sanitary Sludge Shovellers

1983	Dr. Albert Berry
	Sid Dutton
	George Crawford
	Geoff Scott
	Gerry Crossman
	John Patterson
	Fred Woods
1984	Ernie Gloyna
	Charles Ferguson
	Arthur Doran
	Earl Baldock
	Peter Laughton
	Gerry Schwartz

PCAO Day Seminars and Annual Conferences

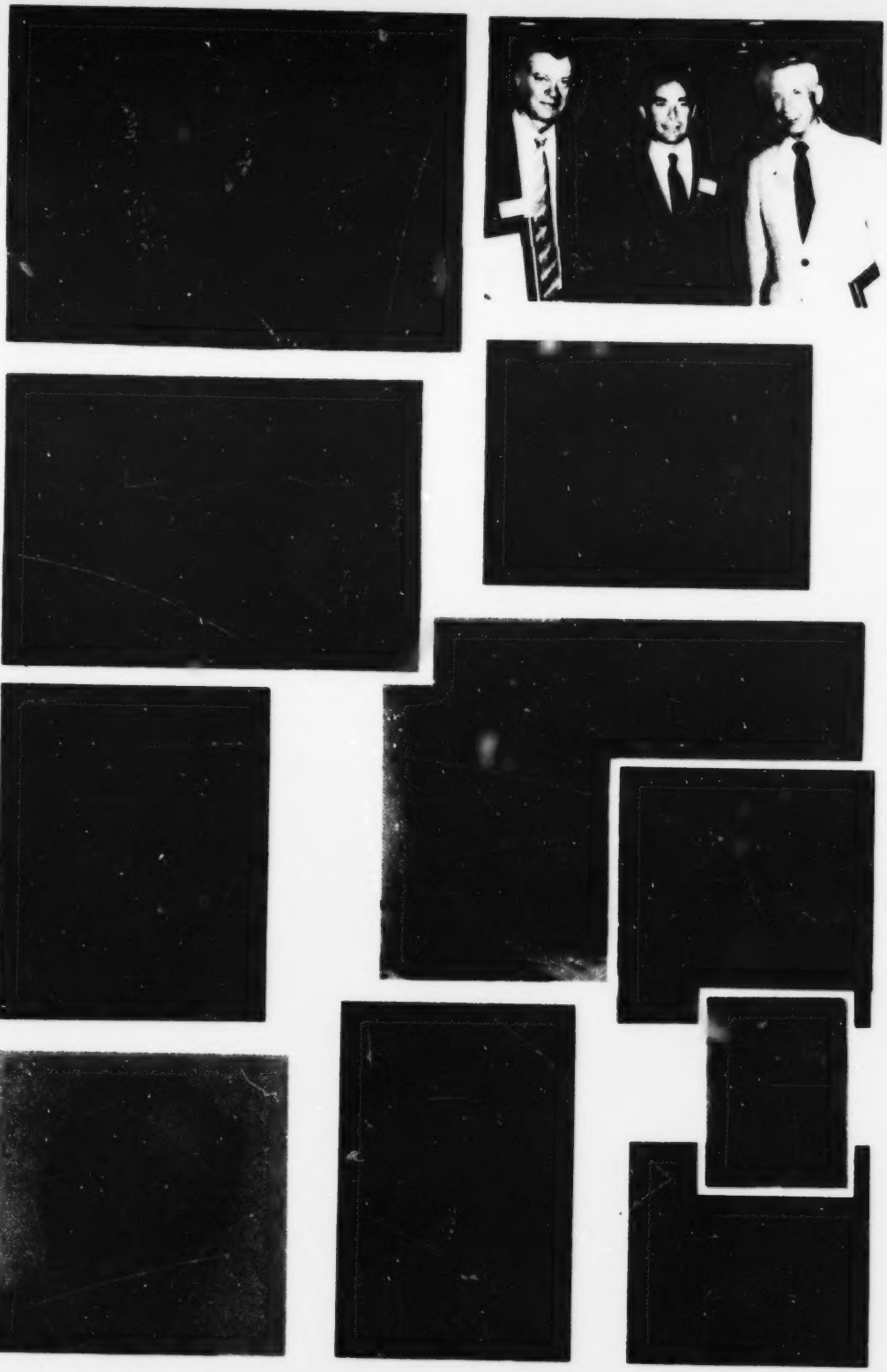
Each year since 1972, the PCAO has jointly sponsored two one-day seminars with the Ontario Ministry of the Environment. These seminars have normally been held at the Ministry of Health Laboratories, Resources Road, Toronto, with the Canada Centre for Inland Waters, in Burlington, being an alternative venue. The seminars have been well attended with the March 2, 1983 seminar "Landfills" drawing a capacity attendance of some 310 registrants. In recent years, a third seminar has been held when a particular topic indicated a need.

Topics have been many and varied over the years and have included:

- Solid Waste Handling and Resource Recovery,
- Sewage Sludge Utilization and Disposal in Ontario,
- Solutions for Industrial Waste Disposal,
- Wastewater Treatment Plant Operations and Maintenance,
- Wastewater Treatment Plant Upgrading,
- Landfills,
- Hazardous Substances in Wastewater,
- Urban Drainage Management,
- Toxic Contaminants in the Great Lakes - The International Challenge.

The PCAO Annual Conferences have been held each year since 1972. Conference locations have varied and have included Ottawa, Hamilton, Toronto, Sudbury and London.

Since 1978, the Annual Conference has been held as a joint conference with the Ontario Section, Air Pollution Control Association (APCA), with the position of overall conference chairman usually alternating each year between the PCAO and APCA designate.



Clockwise from bottom left. Jim MacLaren, Dennis Caplice, Jim Brooker and Terry Fahlenbock, John Patterson and Jim Burry, Gerry Crossman, Gerry Schwartz, (WPCF) and George Crawford, Dave Caverly, Orlando Martini, Peter Eberlee, Ahron Nahmias, and Steve Black (seated), Charles Ferguson and John Reid, Grant Mills, (insert), Gerry Crossman and Arthur Doran, and Ron Mondoux.

The 1983 London conference included the first "table top displays", with ove- 30 members of the Ontario Pollution Control Equipment Association participating. This was expanded in 1984 to also include consulting engineers and suppliers in the air pollution control field.

Annual PCAO Conference Locations

Year		Location	Chairman
1972	PCAO	Skyline Hotel, Ottawa	Sid Dutton, Proctor & Redfern
1973	PCAO	Sheraton Connaught, Hamilton	Sid Dutton, Proctor & Redfern
1974	PCAO	Royal York Hotel, Toronto	Gerry Crossman, Fielding Crossman Assoc.
1975	PCAO/AWWA/ OMWA/FACE	Royal York Hotel, Toronto	Paul Emery, Metro Toronto
1976	PCAO	Skyline Hotel, Ottawa	Sid Love, L.S. Love & Associates
1977	PCAO	Inn-on-the-Park, Toronto	George Powell, Gore & Storrie
1978	Joint PCAO/APCA	Prince Hotel, Toronto	Terry Fahlenbock, Control & Metering
1979	Joint PCAO/APCA	Prince Hotel, Toronto	Steve Black, Ministry of the Environment
1980	Joint PCAO/APCA	Prince Hotel, Toronto	Don Hoskins, Shell Canada
1981	Joint PCAO/APCA	Holiday Inn, Sudbury	Erv McIntyre, Ministry of the Environment
1982	Joint PCAO/APCA	Constellation Hotel, Toronto	Don Gillies, Ontario Hydro
1983	Joint PCAO/APCA	Holiday Inn, London	Doug McTavish, Ministry of the Environment
1984	Joint PCAO/APCA	Holiday Inn, Toronto	Harry McAdie Ontario Research Foundation

Pat Bourgeois, Dave Caverly

Don Redfern

Steve McMinn, poses question at PCAO/MOE Seminar

Dennis Caplice, Geoff Scott

CSCE Meeting at U of T, hears Colin Macfarlane speak on social issues.

CHAPTER TEN

SANITARY ENGINEERING EDUCATION AND OPERATOR TRAINING

Engineering Education Background

In the late 40's and the early 1950's, the principal source of post-graduate education in the pollution control field was the "Dr. Berry Course" at the University of Toronto. This was a program largely emphasizing the state-of-the-art of sanitary engineering in a one-year coursework-Masters-degree program. This program originally began as a public health engineering course. Until the mid 1950's, the majority of attendees were from Provincial Governments, or from military organizations across Canada. By the late 1950's, this program became the principal pre-requisite for the large number of sanitary engineers hired into the newly formed Ontario Water Resources Commission which was to develop an international reputation.

By 1960, at least five practising engineers (R. W. Drynan, C. P. Fisher, P. H. Jones, K. L. Murphy and J. D. Norman) were pursuing post-graduate training in "new era" programs in major universities in the United States. All of them returned to Canada to play a significant role in shaping Ontario's pollution control graduate programs of the 60's and 70's. By the mid-1960's, the University of Toronto, McMaster University, the University of Western Ontario and the University of Waterloo all had graduate programs which emphasized a research approach to problem-solving in the pollution control field.

The principal emphasis of the graduate programs in the 1980's has shifted from the original focus on public health and the subsequent efforts to improve processes for treating municipal and industrial wastewaters, to current concerns about solid waste technology, the fate of trace organics in effluents, the removal of heavy metals from sludges and the problems caused by toxic and hazardous wastes. These changes in approach are reflected in the way water pollution control has been described, starting with Public Health Engineering, then Sanitary Engineering and now Environmental Engineering.

University of Western Ontario

Western University's Master of Engineering (M.Eng.) Program in Environmental Engineering was organized in 1968 by Professors Walter Bulani, a Chemical Engineer, and Ion Inculet, an Electrical Engineer.

Jim Zajic, the first Coordinator of the program (1969/70), was succeeded by John L. Sullivan who served in this capacity for 13 years. Other engineering staff involved in pollution control included Nain Kosaric and John Beekmans.

Unfortunately the program was suspended in 1983 and students interested in water pollution now register in either Civil or Chemical Engineering.

McMaster University

The Engineering Faculty at McMaster was formed in 1959, with the first class graduating in 1962. As it was recognized that Environmental Engineering would be a vital component of engineering education, Dr. Keith L. Murphy was asked to join the faculty in 1961.

Engineering at McMaster under Dean Hodgins emphasized faculty and graduate research and this led McMaster into organizing the First Symposium on Water Pollution Research, in collaboration with the Universities of Toronto and Waterloo, in 1966. In 1966, Dr. J. D. Norman joined the faculty. While the original program was part of the Civil Engineering program, the close cooperation with Dr. D. R. Woods, of the Department of Chemical Engineering, led to the establishment in 1968 of the interdepartmental program which still exists at McMaster. In 1969, a five year $100,000, special development grant from the Department of Energy Mines and Resources allowed increased research activity and funded the appointment of Dr. A. Benedek to the faculty. In 1971, the first of the cooperative research programs with the Wastewater Technology Centre, CCIW, Burlington, was inaugurated. In 1973, Dr. Norman left McMaster and Dr. W. J. Snodgrass joined the program in 1974. In 1976, Dr. Murphy joined IEC (International Environmental Consultants) but remained as an adjunct professor continuing supervision of graduate student projects. In 1980, Dr. Snodgrass left McMaster to join Beak Consultants Ltd. and, in 1981, Dr. A. Benedek relinquished his full time appointment to form Zenon Environmental Inc.

The McMaster program requires all graduate students to undertake a significant research project as a degree requirement. The wide variety of projects reflects the broad interest of the research directors. Major areas of research are biological waste treatment, nitrogen removal, oil separation, chlorination chemistry, activated carbon, ozonation and heavy metal removal. Research at McMaster in the early seventies predated today's concern over residual organics and heavy metals in treated wastes. Some of the original mathematical simulation of waste treatment systems were undertaken by the Wastewater Research Group in the late sixties and early seventies.

Current full time faculty are, Dr. Mario Tsezos (Chemical), Dr. Giles Patry (Civil) and Dr. Donald Woods (Chemical) while part time faculty include Dr. William Snodgrass (Civil), Dr. Keith Murphy (Chemical and Civil) and Dr. Andrew Benedek (Chemical).

University of Waterloo

Environmental Engineering commenced within the Department of Civil Engineering at the University of Waterloo in 1959, as a component of the Municipal Engineering package. Initially, it was directed towards and limited to undergraduate studies. Courses centred upon water supplies, water quality, quality control, both domestic and industrial wastewater treatment processes, water distribution systems and wastewater collection systems.

In 1963, with the return of Dr. W. R. Dryman and, in 1964, of Dr. C. P. Fisher to the faculty, graduate programs at the Masters and Doctoral level were introduced. The undergraduate program was supplemented, and specialized courses were developed in co-operation with other Engineering and Scientific Departments within the University. These programs included industrial health, radiation health, biology and chemistry, statistics, sociology and mathematics, and focused upon the needs and the interests of the students.

To strengthen its environmental component, the Department of Civil Engineering added new staff members: G. M. Cornwall in 1967, G. J. Farquhar in 1968 and E. McBean in 1974.

In 1973/74 a shift in the Department's emphasis from water pollution to water resources took place as some of the staff moved or had already moved on to new challenges. C. P. Fisher went to work for the Federal Government in 1967, to be followed there by G. M. Cornwall in 1972. W. R. Drynan left in 1974 to join the International Joint Commission (IJC) in Windsor.

At present the direction of graduate study in environmental engineering is toward the migration and mitigation of contaminants through soils. Because of the geotechnical requirements for this work, cross-appointments with the Department of Earth Sciences, and with Professor John Cherry in particular, have been implemented.

The Department of Chemical Engineering at the University of Waterloo has also contributed significantly to teaching and research in environmental engineering. P. L. Silveston, who investigated the kinetics and design of clarifiers, and M. Moo-Young, with his studies on industrial fermentation and rate processes in waste treatment, are two of the prominent researchers in this department, active in pollution control.

University of Toronto Department of Civil Engineering

The Department of Civil Engineering has offered a sanitary engineering option at the Master's level for over 60 years. One of the first to earn an M.A.Sc. was Albert Berry for his research in 1924 on refuse disposal. After obtaining his Ph.D. from the School of Hygiene, Dr. Berry lectured on public health and sanitary engineering at the University of Toronto for 37 years, serving, at the same time, as Director of the Sanitary Engineering Division of the Department of Health and later as General Manager of the Ontario Water Resources Commission. The foundations of sanitary engineering in Ontario were laid by Dr. Berry.

Alfred Bernhart joined the Department in 1959 and added courses on water pollution control and, later, on air pollution and urban planning, as interest in the environment grew. In 1966, Rein Laak, a student of Dr. Bernhart became the first Ph.D. graduate in sanitary engineering. Now a Professor at the University of Connecticut, Dr. Laak still pursues his original research on the removal of contaminants by soil.

Before Dr. Bernhart left the university in 1976 to go into consulting, six new staff members were appointed to the Environmental Section of the Department of Civil Engineering.

In 1962, Gary Heinke joined the staff as a lecturer and, in 1964, Philip Jones returned from doctoral studies in Environmental Engineering from Northwestern University in the USA. In 1966, Gary Heinke took a partial leave of absence to complete his doctoral studies at McMaster University.

Subsequently, in 1969, Dr. J. Ganczarczyk joined the staff, first as a visiting professor and, later, as a tenured staff member. Dr. Ganczarczyk came to U of T from Poland with a background in chemical engineering.

Glynn Henry came to the Department of Civil Engineering from the consulting field, first as a doctoral student (until 1971) and, subsequently, as a staff member in 1973.

Newer staff members, such as Dr. B. J. Adams and P. H. Byer, both joined the staff in 1975 and broadened the interests from purely wastewater treatment and allied topics to water resources management, environmental decision-making and solid and hazardous waste management.

University of Toronto Environmental Engineering Program

Following months of discussion, negotiation and compromise, the Environmental Engineering Program was launched in September 1977 as a cooperative venture by the graduate Departments of Chemical, Civil, Industrial and Mechanical Engineering. Glynn Henry was appointed Chairman of the Program.

It has become evident that engineers trained in the traditional disciplines lack an awareness of, and an appreciation for the role of other engineers and specialists with whom they must cooperate in solving today's complex environmental problems. Too often, the alleviation of one polluting source is achieved at the expense of stressing another compartment of the environment.

Twenty-five graduate courses are offered by the participating departments which also provide facilities and supervision for graduate research. In addition, 65 other environmentally-related courses are available in other departments.

Fully equipped University laboratories completely renovated in 1979, provide for biological, physical and chemical determinations on water, waste, soil and air samples. Wind tunnels, hydraulics laboratories, temperature controlled rooms and a mobile laboratory are also available. Other resources include a 700,000 GPD activated sludge plant, access to the facilities of the Wastewater Technology Centre of the Canada Centre for Inland Waters and the University computing and library facilities which are among the largest in Canada. The participating departments maintain extensive workshops to fabricate special equipment required for research.

There are now in the United States and Canada 123 programs in Environmental Engineering, 89 of which operate at the graduate level.

University of Toronto Institute for Environmental Studies

The Institute for Environmental Studies (IES) is probably better known in Vienna, Geneva, Brussels, Paris, Nairobi and the Sudan than it is at its home base at the University of Toronto. Yet, undeniably, it has had a great impact on Canadian water pollution research in general, and Ontario water research in particular.

It evolved in response to society's growing awareness of environmental problems which were emerging in 1967, years before Environment Canada was conceived. Many members of the PCAO have been closely associated with the IES, either as students, researchers or teachers.

Dr. P. H. Jones, a long-time WPCF/PCAO member, worked tirelessly to develop the concept which led to the formation of the Institute of Environmental Sciences and Engineering in 1968. While many people contributed to the idea, few will argue that Dr. Jones was the force which transformed the idea into reality, so it was appropriate that he headed the Institute after it absorbed the Great Lakes Institute in 1971. This development was funded by the Canadian Federal Government. The U of T's Department of Civil Engineering, of course, had a decades-old involvement with environmental matters and the new Institute drew heavily from the University's Civil and Chemical Departments when it was formed.

In 1974, the title was changed to the present Institute for Environmental Studies to better reflect the interdisciplinary nature of the Institute. Dr. F. K. Hare, a well-known geographer and climatologist, succeeded Dr. Jones and became Director in 1974. In 1975, the Institute, in concert with the National Research Council, and other major sponsors organized the first International Conference on Heavy Metals in the Environment. The meeting attracted experts from across the globe to what many believed was the most comprehensive Symposium on Heavy Metals ever presented.

Following completion of Dr. Hare's five year term, Dr. Ian Burton, another geographer, was appointed Director in 1979. The first woman Director, Dr. Pam Stokes, was appointed in July, 1984.

IES's origins go back to the summer of 1967 when Dr. P. H. Jones undertook a study for the Privy Council on Water Pollution Research in Canada.

The Federal Department of Energy Mines and Resources was apprised of the Privy Council Study on Water Pollution Research in Canada and responded by forming the National Advisory Committee on Water Resources Research.

Discussions were commenced with the Department of Energy Mines and Resources concerning a negotiated development grant for establishing a "Centre of Excellence" in Water Resources Research at the University of Toronto. Simultaneously at the University of Toronto, a presidential advisory committee on Environmental Studies was meeting under the chairmanship of Dr. Keith Yates. The outcome of all these discussions was the preparation and submission of a proposal for a negotiated development grant for a graduate multidisciplinary program in Environmental Sciences and Engineering.

The fledgling Institute derived substantial funds from government sources, notably the National Research Council and the Water Sector of the Federal Department of Energy Mines and Resources (later Environment Canada), and the Government of Ontario. The Institute was fortunate enough to receive two major development grants.

Inland Waters Directorate, 1971-74 .....$445,000
Ford Motor Company of Canada, 1971-1974 .....$100,000.

In addition, it received operating grants in the same years for the Great Lakes Institute as follows:

Ontario Department of Energy and Resource Management $300,000
National Research Council .....$258,100.

With the establishment of the Canada Centre for Inland Waters in Burlington, Ontario, much of the raison d'etre of the Great Lakes Institute was removed; the Federal Government had taken over the task so well begun by the late George Langford and Dr. Don Misener (later Emeritus Professor of Environmental Studies). Hence, the Great Lakes funding ended in 1973-74.

During this period of external funding, the Institute built up its small stock of hardware, and created the core of its Resource Centre. It also acquired a central role in Canadian water quality research, including the responsibility for publishing the Journal of the International Association for Great Lakes Research, and the annual proceedings of the Canadian Symposium on Water Pollution Research.

In form, the Institute for Environmental Studies is one of the Centres and Institutes of the School of Graduate Studies and Research. Its mandate is to promote interdisciplinary research into environmental problems. Although it has offered accredited graduate courses virtually since the outset, it is only since 1978-79 that it has had formal responsibility for degree programs. These now consist of six collaborative masters' degree programs administered by the Graduate Departments of Botany, Geography, Zoology, Forestry, Geology and Anthropology. The Institute's role is to provide core courses, and to organize on-the-job internships for the candidates.

In practice, the Institute is the gathering-place for those members of the University facility who wish to involve themselves in interdisciplinary research into environmental problems, or more importantly, into the nature of the human environment.

The international reputation of IES is evidence that it has been successful in blending the social and engineering sciences into a cohesive environmental research body.

Other Universities

Most other engineering schools in Ontario offer undergraduate courses in pollution control. A few provide graduate programs in specialized areas of environmental engineering. These latter include the University of Windsor where J. K. Bewtra has been active for many years in the kinetics of waste processes, and the University of Ottawa where the expertise of Paul Wisner in storm water management techniques has been utilized.

Water Pollution Research Symposia in Canada

Ontario's academic community also anticipated the need for a separate environmental research forum, well before public demands for action in the late 60's.

Although there were many fine researchers doing studies on water pollution research at several Ontario Universities, there was no Canadian forum, or learned journal, where engineers and scientists could present their findings, or discuss them in a milieu, which was primarily an environmental one.

While Water and Pollution Control and Civic Magazines frequently published high calibre environmental engineering papers, they are not

learned journals conforming to the strict publishing requirements, and peer review demanded by the academic fraternity.

In order to ensure the appropriate critical readership and to obtain academic credibility, environmental researchers in various fields had to submit their papers to learned journals in such disciplines as civil or chemical engineering, biology or botany. It became increasingly clear that there was a great need for a multidisciplinary framework which dealt with pollution abatement as the basic theme.

In 1965, a group of academic scientists met with the objective of creating a forum dealing with water pollution research. They included Drs. W. R. Drynan, C. P. Fisher, P. H. Jones and K. L. Murphy.

The first symposium took place at the University of Waterloo in 1966.

Primitive but adequate proceedings were published for the first two symposia which quickly grew in stature. By 1968, when the third was held at the University of Toronto, a National Research Council grant enabled the proceedings to be refereed and published in a quality format, consistent with that of the papers.

Although the symposia attracted prominent scientists from across Canada, they continued to meet in the southern Ontario region, rotating annually amongst the founding Universities of McMaster, Toronto, Waterloo and Western Ontario.

The Canada Centre for Inland Waters joined the editorial committee in 1975. Later that year, Quebec was also represented on the editorial board and Concordia University held a fall symposium, the proceedings of which were published in Water Pollution Research in Canada, Vol. 12. This was an important step in the evolution of these symposia.

Scientists from Western Canada have now expressed interest in becoming involved which will enhance the already sound reputation of the symposia.

However, there is little doubt that the main support of this pioneer Canadian research symposium which provides an increasingly important research base for water pollution research, will continue to operate from the Ontario foundations so firmly established in 1966.

In some two decades, the Symposia have clearly grown from their regional base in Ontario, to a scientific gathering of national importance.

Operator Training

No treatment plant can be better than the people who run it.

Dr. Albert E. Berry, the first General Manager of the Ontario Water Resources Commission, in his message to the October 1960 meeting of the Sewage Treatment Plant Operators' Association stated: "The operator of every sewage treatment plant plays an important part in the water pollution control program. There may be many fine sewage treatment plants in the Province but unless these are operated in an effective and intelligent manner, the results will fall short of expectation."

The importance of proper operation of the Province's water and sewage treatment plants was obvious to the Ontario Department of Health. In the mid-1950's, the Department started special instructional courses for operators of such plants.

In 1956, the Ontario Water Resources Commission was formed, taking over from the Department of Health its Division of Sanitary Engineering and its duties of water management in the Province. The Commission immediately recognized the importance of such courses, particularly since OWRC itself became engaged in the plant-operating business.

Following a short transition period from the Department of Health to the OWRC, a series of graded courses in water and wastewater treatment were developed in 1960.

Under the direction of the Division of Sanitary Engineering, the first course for sewage works operators was held in April, 1961, in the new OWRC laboratory building on Resources Road, Rexdale. This course was followed by a set of courses for both water and sewage treatment plant operators in the latter part of the same year.

Intermediate and senior courses for both programs were developed soon after. Each course concluded with a written examination. Upon successfully completing the three courses, Basic, Intermediate and Senior, the candidate received a Certificate of Qualification, signed by the OWRC chairman and the general manager. The authors of the course material and the instructors were from the various OWRC Divisions, municipalities, consulting engineering firms and industries associated with water and sewage treatment.

The responsibility for organizing and conducting these courses was placed with the Division supervisors of water works and sewage works. This format of training continued until the early 1970's, when the Ontario Water Resources Commission was incorporated into the new Ministry of the Environment.

In 1972, the Ministry established a Training and Licensing Section, (now Training and Certification Section). This Section was given a mandate to expand the existing training program and prepare for implementation of a certification program for operators of water and wastewater facilities in Ontario. The formation of this Section was the result of the introduction under Section 62 of the Ontario Water Resources Act Regulations, Subsection (1) (j) which states that "subject to the approval of the Lieutenant Governor in Council, the Minister may make regulations classifying persons who operate water works and sewage works and requiring and providing for the licensing of water and sewage work operators or any class or classes thereof, and prescribing the qualifications of persons to whom licenses may be issued, and providing for the revocation and suspension of licenses".

Since 1974, the Training and Certification Section has expanded its training program activities to include courses in air pollution control, solid waste management, noise control, visible emission identification, hazardous material handling and disposal, design and construction of municipal water and wastewater systems.

The development and the conduct of the program has been achieved with the cooperation of the appropriate Ministry Branches, other Ministries, the Municipal Engineers Association, Public Utilities Commissions, consulting engineering firms and equipment manufacturers and suppliers. All instructors provide their services free of charge.

The courses are conducted on a year-round basis, between September and May. Most of the courses are of 5-day duration. Currently there are 28 courses, 19 of which are related to water management. The majority of these are conducted several times each year. Annual attendance is usually about 800. This figure does not include approximately 100 operators who attend the annual on-site mini course conducted at various locations across Ontario.

Although the program was designed for Ontario requirements, each year there are a number of course attendees from other provinces and countries.

The Training Centre is located in Brampton, Ontario at the site of a previously-active wastewater treatment plant. At the present time this plant serves as an experimental facility available to any consultant service and "hands-on" training of operators.

At present, the Municipal Engineers Association and the Ministry of the Environment are discussing the implementation of a Voluntary Certification Program for water and wastewater operators. When implemented the certification program will follow the guidelines set by the Association of Boards of Certification (ABC). FACE took an active part in the development of these guidelines to provide a uniform set of standards across North America.

CHAPTER ELEVEN

THE REGIONAL APPROACH

Since streams, lakes and watersheds are oblivious to political boundaries, a regional approach is often the most economical way to provide water and sewerage services. While the concept of regional governments has often been criticized for costly duplication of services, few will argue that water and wastewater treatment services can be less costly and more biologically effective when done on a regional basis. The Niagara Region typifies this approach in Ontario.

In November 1963, the councils of the Counties of Lincoln and Welland, along with the Cities of St. Catharines, Welland and Niagara Falls reached agreement to restructure their local governments. The Mayo Report followed after many meetings, and enabling legislation followed years of reports, studies and administrative restructuring. Finally, the Regional Municipality of Niagara came fnto being January 1, 1970.

A major study of sewerage and water systems was a priority of the new Region which had assumed all water treatment plants, water storage and trunk distribution systems, as well as pollution control plants and trunk sewers within its boundaries. This study gives us some historical data for several early plants. The study found that the majority of treatment facilities, particularly in the pollution control field, were totally inadequate from both a capacity and treatment capability. An integrated review of all water and sewerage systems was necessary and a consortium of engineering consultants consisting of R. V. Anderson Associates Ltd. and Proctor & Redfern Ltd. was formed with the acronym "PARC Niagara".

PARC Niagara undertook to carry out a servicing master plan study which encompassed an inventory of existing facilities, establishment of design criteria, review of all relevant reports, development of conceptual schemes for both water and pollution control and preparation of cost data which could be utilized for capital budget purposes. In the absence of a regional official plan, servicing concepts were developed on the current population projections and land use designations. It was anticipated that the concepts and timetables presented would be flexible and allow for each revision to match changing growth patterns as well as the financial capacity to undertake works.

The report recommended that water systems be reduced from a total of 15 to an ultimate eight systems.

The Region originally assumed 19 separate sanitary collection and treatment facilities. The ultimate concept is based on a reduction to approximately 11 systems.

The PARC Niagara report also considered solid waste disposal.

The firm of James F. MacLaren Limited was retained by the Region to report on the assumption of sewage and water treatment plants. The report was entitled "Initial Assumption, Operation and Financing of Water Production, Treatment and Storage Works, Trunk Sewers and Watercourses". The principles of assumption as prepared were forwarded as recommendations to a supervisory committee on October 15, 1969 and

subsequently approved by the Public Works and Utilities Committee and Regional Council in December of the same year.

The actual control of operation and the transfer of personnel to regional payroll, progressed gradually. The first plants were taken over from February 9, 1970 and, by the end of March, all plants were under Regional control, except those under the ownership and operation of the Ministry of the Environment. It was not until December 1970 that agreement was reached with the Ministry for the official take-over of provincial plants and the transfer of employees.

Sixteen sewage systems were assumed in 1970, four of which have been phased out of regular operation and the service taken over by adjacent systems.

On the Region's 10th Anniversary in 1979, the total capacity of all sewage systems was 62.56 million gallons per day. This was a far cry from the late 1920's, when the first municipal sewage treatment began in the area. It was during this era that the communities of Bridgeburg (now Fort Erie), Grimsby, Crystal Beach and Port Colborne constructed sewage treatment facilities.

In the late 1940's, Niagara Falls proceeded with sewage treatment by providing settling tanks, constructed on combined sewer overflows to remove solids before discharge to the HEPC canal. In addition, a lagoon was built in the Chippawa area for solids removal prior to discharge to the Welland River.

The 1950's saw expansion to the biological treatment of sewage at the Grimsby main plant and the East Side plant in Port Colborne, construction of the Grimsby Beach and Beamsville plants which used trickling filter systems for sewage treatment, and construction of the Port Weller sewage treatment plant. The woefully inadequate septic tanks system in Bridgeburg was replaced with a primary sewage treatment plant and chlorination facilities were included for the disinfection of the plant effluent.

West Grimsby, Smithville, and Niagara-on-the-Lake each constructed waste stabilization ponds in the early 1960's. During this same period, primary sewage treatment facilities were constructed in St. Catharines and Welland. The City of Port Colborne constructed a new West Side plant employing primary and secondary treatment, while in Crystal Beach, a new activated sludge treatment plant was built.

The 1970's were busy years for the Towns of Grimsby and Lincoln. The Baker Road sewage treatment plant was constructed in Grimsby to provide conventional activated sludge treatment with digestion, for both communities. Its completion was the death knell for the Grimsby Main, Grimsby Beach, and Beamsville plants.

St. Catharines, Lincoln and Grimsby upgraded their sewage treatment facilities to accommodate growth and more stringent environmental legislation. Treatment plants in both the City of Niagara Falls and the Town of Fort Erie were physically doubled in size. The Welland primary plant was expanded and converted to secondary treatment, while waste stabilization pond expansions were undertaken in Niagara-on-the-Lake, Grimsby, and Smithville. A new sewage treatment plant was constructed

in Port Colborne to replace the aging East Side facility and in the foreseeable future, the West Side plant.

Phosphorus removal facilities were installed in all of Niagara's plants and resulted in the need for larger final clarification surface areas. In addition, the volumes of sludge increased significantly, affecting the overall sewage treatment costs and also causing more problems with disposal of the digested sludge. As a consequence of public opposition to the establishment of temporary holding cells, the Region had made little progress by 1982 in sludge disposal, a situation further compounded by the Ministry of the Environment's proposed sludge disposal guidelines.

Niagara Falls - Stamford/Niagara Plant

Over the years, the growth of the sewerage system for the City of Niagara Falls and the former Stamford Township was governed by the needs of the immediate locality. Originally, all surplus surface water and all sanitary and industrial waste originating within the city were allowed to flow directly into the Niagara River, while those originating in the township were partially treated in settling tanks from which the effluent discharged into the Welland River and the HEPC canal. Water in the canal, after passing through turbines, rejoins the Niagara River some five miles downstream from the city.

When the time came for each municipality to consider the best means for curtailing pollution of the Niagara River, it soon became evident that treatment of sewage would be more economically accomplished by a comprehensive scheme serving the overall needs of the entire area. At that time, the possibility of complete amalgamation of municipalities within the Counties of Lincoln and Welland was under urgent debate and joint municipal services, including pollution control, became important factors in such discussions.

A co-operative and realistic attitude resulted in the planning and eventual construction of a sewer system during 1962 and 1963 to deliver the greater part of waste produced in the area to primary treatment plants for the removal of much of the pollution.

The City of Niagara Falls and the Township of Stamford amalgamated on January 1, 1964, to form the newly-enlarged City. Additional pumping stations, forcemains, interceptors, plant expansions, and construction of digested sludge holding lagoons were completed between 1965 and 1979.

The City of Niagara Falls is a good example of the concept of a central treatment facility with a trunk collection system. When regional government was formed, the new city encompassed the Village of Chippawa, most of Willoughby Township and the eastern half of Crowland Township. At this time, the Village of Chippawa was planning an expensive expansion of its sewage treatment plant. The possibility of servicing the community through the City's sewer system was investigated and found to be a preferable alternative to plant expansion. This development became known as the South Side sewer scheme.

The sewage treatment plant in Chippawa was both hydraulically and biologically overloaded. The Niagara Falls plant had sufficient capacity to include the Village and all proposed development in the

area. With construction of the South Side sewer scheme in 1975, the Chippawa plant was phased out of service; the McLeod Road sewage tank which discharged into the HEPC canal was eliminated as well as the Stanley Avenue lagoon which discharged to the Welland River. In addition to abating three sources of pollution problems, this scheme provides an ultimate drainage area which includes future development in the south-west area of the City of Niagara Falls.

Port Colborne

Until 1928, pollution control in Port Colborne consisted of septic tanks and outside privies. In that same year, however, the town council commissioned the installation of sanitary sewers, forcemains and plants. As the municipality is split by the Welland Canal, it was necessary to build two complete sewerage systems. The original system on the west side of the canal had four pumping stations on a single forcemain, pumping to the West Side treatment plant on King Street. It was an activated sludge plant without primary clarifiers, equipped with a heated digester, sludge drying beds under glass and an outfall to the Welland Canal. This was duplicated on the east side, with sewage being pumped to the East Side treatment plant on Killaly Street. In 1947, the East Side plant was expanded. When a new West Side plant was constructed in 1961, the original plant was demolished.

Phosphorus removal facilities were added to both the East and West Side plants in 1975.

Welland

A sewage treatment plant was built in the south-east section of Welland and put into service in 1932. It was a simple primary treatment plant with raw sludge lagoons and effluent discharge into Lyon's Creek. The plant was taken out of service due to gross overloading and replaced with a pumping station to pump sewage directly into the creek. The installation of new lift pumps and forcemains in 1956 permitted discharge into a gravity sewer and ultimately the Welland River.

As early as 1947, discussions were held between Crowland and Thorold Townships and the City of Welland regarding trunk sewers and a regional sewage treatment plant. Several obstacles were encountered and discussions ceased for several years. A study and report were presented in 1954, but agreement could not be reached on many of the recommendations, particularly the costing for remote rural locations. Each municipality continued its own local sewer program, with Welland doing some separation and installation of storm and sanitary trunks. After annexation of the urban area of Crowland Township by the City of Welland in 1961, R. V. Anderson Associates Limited was hired to do a study and report on storm, sanitary and combined sewerage facilities, including a sewage treatment plant. In April 1963, the 96-inch Wellington St. combined trunk was completed to take sewage from the east side of the city and, eventually, from Ridge Road industrial park, Dain City and Cooks Mills.

The city then began a ten-year program to sewer the entire community, treat all sewage and eliminate 35 outlets which dumped raw sewage into the Welland River. When the Federal Government announced the Welland Canal by-pass in late 1965, some plans and scheduling had to be changed,

but the south bank interceptor sewer was completed in September 1975 and all sewers were connected to the treatment plant.

The primary treatment plant was opened in 1968. Four years later, sewage was accepted from the Town of Fonthill, making the Welland plant the first, true regional facility in Ontario as it was servicing two municipalities. A secondary treatment plant was commissioned late in 1974. Upon completion of these two major projects, all sewage from the city was given secondary treatment, with the exception of rural areas which were on septic tanks.

Fort Erie

The original Town of Fort Erie started its sewer system in 1923 with the construction of the Catherine Street pumping station. The installation of sewers on all streets "below the hill" between 1924-1925 replaced outhouses and septic tile beds. It is presumed that, during the period 1926 to 1931, sewage was discharged into the Niagara River at the foot of Gilmore Road. During this same period, Bridgeburg, now Fort Erie North, installed a sewer, starting with a large septic tank, and installing sewers on the main streets south to the railway. In the winter of 1930-31, a collector sewer was installed from Gilmore Road to Jarvis Street to join Fort Erie and Bridgeburg prior to amalgamation in 1932.

Additions were made to each system which operated until 1963 when the former Ontario Water Resources Commission and the Municipality built a sewage treatment plant on Anger Avenue. A septic tank on Bowen Road was replaced by the Parkway pumping station which pumped all town sewage by forcemain to the treatment plant.

In the Crystal Beach area, a septic tank with aeration and chlorination of effluent was built in 1926. Two additional pumping stations were added in 1968 to accommodate subdivisions. The new plant was built and opened in November of 1969. The West Bertie system for the Ridgeway area was started in 1975. Two pumping stations were built to get sewage to the Crystal Beach plant. In 1977 a contract was awarded to double the capacity of the Anger Avenue plant, with substantial completion in August 1979.

In June 1974, the Region assumed operation of all existing pumping stations and, in 1978, assumed operation of the new Industrial Park pumping station.

Regional Niagara is in the preliminary stage of establishing a collector system to accept sewage from the Stevensville/Douglastown area.

Grimsby

The Grimsby Beach sewage treatment plant, consisting of a dual-purpose tank and trickling filter, complete with a local sewer system for the beach area, was built in 1954 at an approximate cost of $30,000. The facility, located on the beach about 350 feet west of Park Avenue, was operated by the former Township of North Grimsby. Ten years later, the plant capacity was increased, more sewers added to the system and an effluent pump installed to discharge treated sewage to the lake through 125 feet of four-inch submerged outfall pipe. When the Region assumed the operation of this facility in 1970, it was found to be overloaded

and in need of many repairs. The plant suffered constant vandalism and the trickling filter was out of operation much of the time. Repairs and alterations were kept to a minimum until 1977 when the plant was taken out of operation and the flow picked up by the Park Avenue trunk sewer for treatment at the Baker Road plant.

The original main treatment plant was constructed about 1930 and was designed to serve the section of Grimsby south of the Canadian National Railway, an area of about 193 acres. It was an activated sludge system in its original concept but provided neither primary nor sludge treatment for sewage. The unchlorinated effluent discharged to Lake Ontario via Forty Mile Creek. To improve efficiency and increase capacity, the plant was expanded in 1947-1948. A pumping station was added. High concentrations of heavy metals from local industries prevented the digester from operating properly. In due time, the plant became hydraulically overloaded because of the combined sewers. Biological overloading was relieved when a local canning factory ceased operations. When the Region assumed the facility in 1970, it was overloaded and in poor condition. Repairs, additions and alterations were kept to a minimum because of the anticipated replacement of the facility. The plant ceased operations in 1977 and was replaced by the Lake Street pumping station which pumped the town's sewage to the new Baker Road plant.

The Baker Road pollution control plant, completed in 1977, was designed for the Ontario Ministry of the Environment to serve a population of approximately 24,000 in its initial stage and is operated by the Regional Municipality of Niagara. Six pumping stations collect sewage from the Towns of Grimsby and Lincoln.

The plant was built to allow for easy expansion in the future, with an initial design flow of four million gallons per day. Since the start of operations, the dry weather flow has been less than half the design flow and, consequently, only half of the primary clarifiers, aeration tanks and final clarifiers have been utilized. Storm flows in Grimsby and Beamsville, however, have been in excess of plant capacity and sewage was bypassed to the lake on such occasions.

New pumping stations on Roberts Road in Grimsby, Victoria Avenue in the Vineland community and two stations in the Jordan area were constructed which resulted in increased flow to the plant.

Port Weller

The first sewage treatment plant in the St. Catharines area was officially opened in December, 1951. Actual construction of the primary treatment plant was done in conjunction with the laying of the main trunk sewer in 1949. The site covered an area of approximately two acres and was bounded on the west by the Municipal Beach along the shore of Lake Ontario and on the east by the Welland Ship Canal. Previous to the opening of this facility, all domestic and industrial wastes were dumped into various waterways leading into Lake Ontario. The plant was soon grossly overloaded, with sewer hookups to the main trunk by Merritton and Thorold, and other parts of St. Catharines east.

In September, 1969, construction began on the new Port Weller secondary treatment plant. This project was initiated by the City of St. Catharines. Upon completion of the work, the facility was assumed by

the Regional Municipality of Niagara. The total cost of the works, including engineering, was approximately $3.8 million. A further 12-acre parcel of land was leased from the St. Lawrence Seaway Authority to accommodate the works. The plant was officially opened October 28, 1971. Since then, several additions have been made, including the covering of the influent channels and lift pumps. A new building was constructed to cover the detritor section to control the odours.

Port Dalhousie

The Port Dalhousie pollution control plant was developed in two stages; the first, completed in 1967, provided primary treatment only. Raw sewage, which had previously flowed directly into Port Dalhousie Harbour, was diverted through the plant for treatment.

The secondary treatment plant expansion got underway during 1974. Phosphate removal facilities, plus odour control units, were included. With the addition of secondary treatment and certain modifications to the primary plant, the rated capacity increased to 13.5 MIGD with a peak hydraulic load of 27.0 MIGD.

The plant was officially opened in July, 1976, and has operated quite successfully to this date.

Lincoln

In November, 1949, construction of sanitary sewers and a sewage disposal plant to service the Beamsville area, in the Town of Lincoln, was approved. The plant, built at a cost of $185,000, consisted of a charcoal filter, trickling filter and a final clarifier. The charcoal filter operated for only a few years due to the many problems associated with its use and several plant modifications were required.

When the plant was assumed by the Niagara Region in 1970, it was overloaded and badly in need of repair. There were no plans or specifications available, but the Region was fortunate to obtain the services of Mr. I. Knafelc, the only operator the plant ever had. A new 24-inch trunk sewer was built along Ontario Street and a submersible lift pump was installed in a manhole alongside the plant. Repairs were frequent, but kept to a minimum because of anticipated replacement of the plant. The Beamsville plant ceased operation in late 1977, when the new Ontario Street pumping station was commissioned and sewage was pumped to the Baker Road plant.

Garden City Lagoon

The lands for the Garden City lagoon were purchased by the Jockey Club of St. Catharines in 1963 and are located south-east of the QEW and east of Taylor Road in the Town of Niagara-on-the-Lake. The lagoon property was later purchased by the Town specifically to service the raceway. The lagoon consists of two cells which discharge through control chambers to a natural waterway flowing into Six Mile Creek.

The raceway closed in September 1976 and the Garden City lagoon, using one cell, now accepts wastewater from the newly-constructed White Oaks Tennis and Racket Club. The second cell will be put into service when the new Foster-Wheeler office complex is completed.

Biggar Lagoon - Grimsby

In 1962, plans were drawn up for a sewer system and the 5-acre Biggar lagoon to serve the west end of North Grimsby Township, below the escarpment. Construction was completed in 1963. The effluent from the lagoon was discharged to Lake Ontario via a local drainage ditch. The system soon became overloaded and, since 1967, two three-quarter acre aeration cells and an additional one-acre cell were added to accommodate the added flows and particularly the wastes from a large winery. The facility was again expanded in 1975, with a one-acre cell and a 40 hp aerator mounted in the centre on a stationary steel platform. A 9.2-acre polishing pond was also added at this time. In recent years, heavy infiltration occurred during rain storms and spring thaws and the pumping station could not handle the extraneous flows. Eventually the station will be phased out and flows pumped to the Baker Road plant.

Niagara-on-the-Lake Lagoon

The Niagara-on-the-Lake lagoon is situated on crown land administered jointly by the Department of National Defence and Parks Canada. Under the terms of an agreement, the Region of Niagara expects to get patent on the land where the original two lagoons are situated, with a proviso that, if no longer required for lagoon use, the lands will revert to the Federal Government. The site of two aeration cell additions, constructed in 1977, is expected to be leased to Niagara for 40 years, subject to the same condition.

It is interesting to note that the land is adjacent to the Canadian Army firing range and, if shells are actually fired over the lagoon, this possibility will have to be considered in any patent or lease agreement.

Prior to lagoon construction, wastewaters from the town were gravity fed directly into Lake Ontario; wastewaters from the Virgil community were fed into septic tanks.

Four pumping stations and the original two cells were put into service in 1963. The lagoons provide natural purification; effluent is discharged into Two Mile Creek which flows into Lake Ontario. The system was expanded in 1978, with the addition of two aeration cells. The expansion accepts wastewaters from the Virgil community and will accommodate future expansion of the old Town of Niagara-on-the-Lake plant. The lagoon system now receives waste from 10 pumping stations.

Smithville, West Lincoln

With the approval and financial assistance of the Ontario Water Resources Commission and the Central Mortgage and Housing Corporation, the former Village of Smithville was provided with sewers, a pre-fab pumping station and a 9.0-acre lagoon. The completed system became operational on January 1, 1964. By 1967, the system was nearing design capacity and was also receiving some industrial wastes which were causing deterioration in the effluent quality. The Commission issued a warning that development in the Village might be curtailed because of inadequate sewage treatment.

A consultant's report, presented in July, 1969, gave the estimated population and flows for the next 20 years, treatment units required and approximate cost for the program. An update of the report in April 1970

recommended the construction of two additional cells, a new 10-inch forcemain, new pumps and motors and a diesel generating set. No work was undertaken on the treatment facility between 1969 and 1974, but the Village continued its efforts to improve the sewer system and eliminate sources of extraneous water. Although contracts were awarded to upgrade the Smithville sewage works, many complications and delays were encountered and the work was not completed until January 1976.

Since early in 1977, there has been continuing dialogue with the Township of West Lincoln, the Ministry of the Environment, the consulting engineers and Regional Niagara concerning the additional population which could be accommodated by the pollution control treatment facilities. It has been agreed by all parties concerned that population growth will be allowed to increase to a maximum of 2,700 persons (or equivalent) subject to certain conditions.

With regard to water pollution, the Region assumed limited treatment facilities as well as the legal liability to comply with mandatory orders for the provision of secondary treatment. By 1981, nine facilities had been expanded and/or initiated. The total increase in treatment capability is in the order of 25 MIGD dry weather capacity. With the exception of four lagoons and two treatment plants with outfall to the Niagara River, all other plants provide secondary treatment. In 1973 and 1975, the Region completed, in accordance with provincial requirements, the installation of phosphate removal facilities. While the program required the assumption of capital debt from area municipalities and incurred major expenditures for the new aforementioned facilities, the Region has also been successful in securing both financing and subsidies from the Federal and Provincial Governments which assisted in keeping this overall debt at a reasonable level.

CHAPTER TWELVE

PROJECTS

Word of the "activated sludge process" developed in England in 1914 by Ardern and Lockett appeared to have an early influence on officials at the City of Toronto Health Department. A 1927 English publication "The Activated Sludge Process" by A. J. Martin outlines two experiments conducted by the City of Toronto Health Department over the 1916 to 1921 period. The text of the article gives a fascinating insight into the early research in this area and has been included as a preface to the subsequent discussion on some of Ontario's treatment facilities:

"The diffused air method has been extensively adopted in Canada, where no fewer than twenty installations have already been laid down. The low cost of electricity in many parts of the Dominion, due to the abundance of water-power, has favoured the introduction of the process.

"Toronto Experiments. - The Health Department of the City of Toronto carried on a series of experiments with the process, extending from 1916 to 1921. Nasmith, who had these experiments in hand, was early impressed with the difficulty of de-watering activated sludge. He was satisfied that for a long time to come there would be no economic solution of this problem, and accordingly set out to find means of disposing of the sludge by digestion.

"A preliminary experiment was carried out with the sewage of a cottage of four inhabitants, using three small biolytic tanks in series (Fig. 41). In the top of the tanks were introduced contact-surfaces of interlaced 1 1/2 in. by 3/8 in. builder's laths, mounted on horizontal axles, immersed to a depth of about 40 percent of the diameter, and caused to rotate slowly without disturbance by a small motor. The volume of the contact material amounted to about 1 1/2 cu. ft. per person. The house sewage was led down towards the bottom of the first tank, which overflowed through a pipe which passed to nearly the bottom of the second tank, and so on to the third tank, and from the top thereof to open tile distributing drains without the use of a siphon.

"The tanks were put in operation for about a year without the rotating contact filters. At first with this arrangement there was much offensive odour, but after a time this was reduced very considerably, with the formation of black sludge, most of which was in the first tank and very little in the third. The effluent was straw-coloured, but otherwise clear, and strongly colloidal; and it was evident that a considerable amount of the originally precipitated matter was being liquefied and carried away in the effluent.... The air treatment with the rotating contact-surfaces was insufficient to produce a thoroughly oxidised effluent, but the appearance and smell of it were greatly improved. It seemed probable that very little oxidising effect was produced in the first tank of the series; and though no scum collected, the surfaces of the laths soon became choked with debris. In the second tank the contact-surfaces did not

choke, but their black colour showed that the oxidising organisms did not develop. In the third tank of the series the well-known colour and odour of the activated sludge was fully developed, but, as these surfaces in the third tank provided only 1/2 cu. ft. per person, they were not sufficient to yield a thoroughly oxidised effluent. This experiment led to the important conclusion that decomposition and aeration could proceed in the same tank under certain conditions without mutual interference, though the desired conditions needed further study.

"A small apparatus was then constructed at the experimental station carried on by the City of Toronto Department of Health, in which the three processes of digestion, aeration and final settlement were carried out in the separate compartments of a single tank. In the beginning of this experiment the first compartment was filled three-quarters full of ripe digested sludge from an Imhoff tank. Screened and partially settled Toronto sewage, containing about 100 parts of suspended solids per million, was fed into this compartment near the bottom. After passing upwards through the sludge, the sewage spread out in the upper portion of the compartment and overflowed into the second compartment, which contained filtros plates and where it was aerated. From near the bottom of this compartment it passed upwards through an inclined spout, in which the activated sludge settled out and slipped down again into the aeration compartment... Providing the settling tank in the form of a spout was kept free from deposits, this second experimental apparatus, with little attention, worked well and yielded an effluent of very high quality... Except for testing purposes, no sludge was withdrawn from the decomposition compartment, and very little sludge collected during the two years the apparatus was in operation. A small amount of sludge was undoubtedly lost.

"A larger apparatus, shown in Fig. 42, also effected a high degree of purification, though the results were not so good as those from the smaller apparatus. The average consumption of air was 1 cu. ft. per imperial gallon; but for some periods 1/2 cu. ft. was employed, without any noticeable change in the effluent.

"The new feature which is particularly interesting in connection with this process is that a sludge has been discovered that has both the characteristics of activated sludge and digesting sludge. This sludge, unlike activated sludge, will decompose without offence if allowed to stand under anaerobic conditions. Presumably it was formed by particles of typical digesting sludge being carried over into the activated sludge chamber and there built up by aeration and scrubbing into the particles of activated sludge. If this theory is correct, then the proportion of digesting organisms is sufficiently large to overcome any tendency to putrefy. This new feature can be applied to existing activated sludge plants with success by bringing the raw sewage in contact with digesting sludges or by adding more or less continuously a small quantity of well-ripened digesting sludge to the activated sludge being circulated and aerated. The excess sludge will then, if allowed

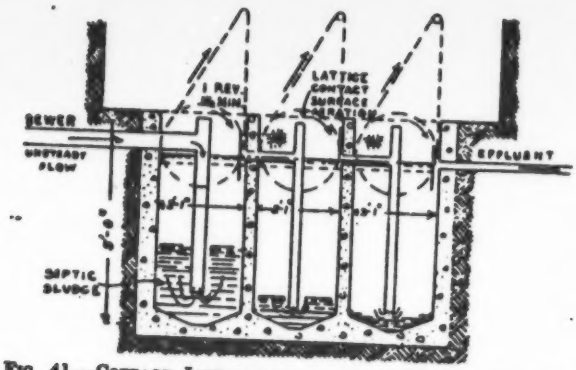


FIG. 41.—COTTAGE INSTALLATION AT LONG BRANCH, ONTARIO.
[By courtesy of "The Surveyor."

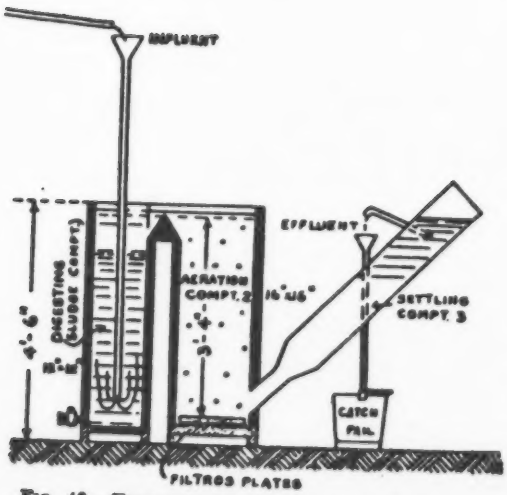


FIG. 42.—EXPERIMENTAL APPARATUS AT TORONTO.
[By courtesy of "The Surveyor."

Figures as referenced in the 1927 London, England publication "The Activated Sludge Process" by A.J. Martin.

to stand, digest without offence, yielding a sludge with the inoffensive characteristic tarry odour of good Imhoff sludge with its good drying qualities" (Surveyor, 3rd July, 1925, pp. 3-5)."

Ontario has built plants at a rate unmatched anywhere in Canada. The following is an overview of some of the Province's treatment facilities.

(a) **Municipal Water Pollution Control Facilities**

Canada's Largest Activated Sludge Treatment Facility

The Main Treatment Plant in Metro Toronto, is Canada's largest wastewater treatment facility with an activated sludge section nominal capacity of 180 MIGD. Gore, Nasmith and Storrie Limited, of Toronto, and Metcalf & Eddy Limited of Boston, commenced studies and design work in the early 1930's and over the years the project was continually expanded and improved. Today, the huge plant employs primary settling tanks, aeration and final settling tanks, anaerobic sludge digestion, thermal conditioning, dewatering, incineration and phosphorus removal. While the two firms initially collaborated on design work, Gore & Storrie Limited has been the sole consultant for the years when the Main Treatment plant has been dramatically expanded and modernized.

The plant treats more than 50 percent of Metropolitan Toronto's sewage. Recent expansions have increased primary treatment capacity to a nominal 300 MIGD (dry weather) and provided vastly improved sludge treatment and disposal facilities.

The latest extension gives Metro Toronto one of the largest thermal sludge conditioning facilities in the world. A 608 foot stack discharges exhaust gases from the sludge incinerator, while the stack's annular ring conveys treated gases from the aeration and primary settling tanks giving effective odour control. A computerized digital control centre commands most process controls with flows displayed, alarms indicated, and logs kept automatically.

The Main Treatment Plant pumping station, with its 255 MIGD capacity, won an award of merit in the 1975 design competition sponsored by Canadian Consulting Engineer Magazine and the Association of Consulting Engineers of Canada. The circular structure extends 86 feet below grade to 48 feet above ground level and is 85 feet in diameter. The structural design of the station incorporates post tensioned concrete, architecturally styled to blend with the surroundings and adjacent buildings. It was the largest pumping station in Canada, when first constructed, and is remotely controlled by the Main Treatment Plant's computer system.

Humber Treatment Plant

The Humber Treatment Plant, servicing the western portion of Metro Toronto, is one of Canada's major pollution control centres. In 1954, James F. MacLaren Associates commenced a staged program which saw the plant develop from the original concept through to its present-day treatment capacity of 90 MIGD.

In 1954, a report was prepared on the preliminary design. Then, in 1956-60, design and construction services were provided for the 50 MIGD primary and secondary treatment systems, at a cost of $17,700,000. These included screening, grit removal, primary sedimentation and diffused air biological treatment with sludge processing by anaerobic digestion, vacuum filtration and landfill disposal.

In 1964-70, the capacity of the primary and secondary treatment systems was increased to 60 MIGD at a cost of $11,800,000 and conceptual designs were prepared for future sludge incineration. In 1973, the plant capacity was increased to 90 MIGD, and included the covering of existing and new "deep" aeration tanks, odour control, phosphorus removal, computer-aided supervisory control and energy conservation measures. The cost of this expansion was $40,000,000.

The proposed ultimate capacity of the Humber Treatment Plant is in the order of 120 IMGD.

One of the significant energy conservation features in the initial construction program of the new Humber Treatment Plant was the provision of four dual fuel engines of 900 hp, operating primarily from the methane gas provided by the sewage sludge to drive air blowers, with their collected exhaust gases and cooling water utilized for building and digester heating.

Hamilton Water Pollution Control Plant

The Hamilton treatment facility achieved national distinction in 1975 when it won an award of merit in the Building and Components category of the Governor General's Awards' program. It was designed by Proctor & Redfern's Waste Treatment Department, then headed by C. S. Dutton, a former PCAO President, and G. A. Singleton, head of the firm's Architectural Department.

The plant's primary treatment phase was designed earlier by Proctor & Redfern. The secondary phase was completed in 1975 for about $25 million.

The secondary treatment extension provides activated sludge treatment, dissolved air flotation for waste activated sludge thickening, additional digester, filter and boiler capacity, sludge incineration, standby power facilities and landscaping. It has a treatment capacity of 60 million gallons per day, with a hydraulic capacity of 120 MGD for future extension.

The project had several notable features. It involved, at that time, the largest single contract ever let in Canada for a pollution control facility. The 80-foot-diameter methane gas sphere was also the largest in the country, as were the four 83-inch-diameter Archimedean screw pumps.

The total quantity of concrete in the project was 60,000 cubic yards, of which 1,600 cubic yards were poured in a single day, mainly for the flotation building and aeration tanks. This quantity was uniquely high for a single day's pour, and the flotation tanks themselves were, at that time, second in size only to an installation in Denver, Colorado.

The methane gas, generated in the digestion process, was intended to be used as alternative fuel for the 1,000 kilowatt/4,160 volt diesel generators during peak periods (not just as an auxiliary measure), permitting reduced electrical rates for the facility. The gas is also used as fuel for the sludge incinerators, to fire the steam boilers for heating the buildings, and in the digestion process.

Four methane or natural gas fired boilers generate steam for the plant's space heating and process requirements. Steam is also supplied to the nearby water purification plant.

Landscaping and architecture played an important role in the facility's design, its aesthetic qualities greatly enhancing its surroundings. Appropriately, the late W. B. Redfern, a founder of the consulting firm, stressed the importance of aesthetic considerations for treatment plants, in a paper written 40 years earlier. Mr. Redfern said landscaping, and flowers fertilized by treated sludge, could greatly assist in gaining public acceptance of sewage plants.

Highland Creek Sewage Treatment Plant

The eastern portion of Metro-Toronto is serviced by the Highland Creek Sewage Treatment Plant, designed by Proctor & Redfern Limited. First begun in 1954, the facility was expanded in phases until, by 1982, it had a 48 MIGD capability, with provision built in for an ultimate 64 MIGD loading, being completed at the time of writing.

The influent building has odour control with the air continuously extracted and deodorized by ozonation before discharge to atmosphere.

Eight 75-foot-diameter circular aeration tanks have a liquid depth of 30 feet. Primary effluent is fed to the centre of each tank for effective mixing and the aerated liquor is collected by circumferential weirs for effective mixing. Each tank has three mechanical surface aerator units with draft tubes and the entire aeration complex is housed for odour control, the air being extracted and deodorized by chlorine and caustic scrubbing. The plant also has an additional mechanical aeration and diffused air section operating in the standard mode.

The four secondary clarifier units are also circular, with a diameter of 115 ft. and a side liquid depth of 12 ft. Sludge removal is carried out with hydraulic removal mechanisms. The activated sludge pumping station is equipped with four screw pumps, each 45 ft. long and almost 6 ft. in diameter. Several square clarifiers also form part of the secondary clarification facilities.

An unusual feature of all three sections of the plant is that the waste activated sludge is not returned to the primary clarifiers, but thickened by dissolved air flotation before being conveyed to the sludge treatment and disposal system.

There are three dissolved air flotation units for the thickening of waste activated sludge, housed in a building large enough to accommodate two future flotation units. Thickened waste-activated sludge, primary sludge, and digested sludge from the existing plant are blended and taken to a Porteous Process sludge treatment and disposal facility. Dewatering of the heat treated sludge takes place by centrifuging, followed by incineration of the sludge cake in multi-hearth furnaces.

South Peel Sewage System

The South Peel system was a pioneer in treatment schemes servicing a large area.

In conjunction with the South Peel water system, the Ontario Water Resources Commission provided trunk sewer and treatment facilities for handling sanitary sewage from the five area municipalities.

Canadian-British Engineering Consultants Ltd. was retained as the prime consultant on the sewage project and in December 1968, the OWRC and the five municipalities involved in the plan -- Mississauga, Port Credit, Streetsville, Brampton and part of Chinguacousy Township south of #17 Sideroad, signed agreements to provide water and sewage facilities for these municipalities. Two main trunk sewer systems were recommended, one running north to south generally through the valley of the Credit River (West Trunk Sewer), and the other north to south in the valley of the Etobicoke Creek (East Trunk Sewer). Each sewer was designed for 30-year development with provision for a second parallel sewer at that time to bring the combined capacity to ultimate requirements.

The goal of the system was to provide a long range program, eliminating discharge of sewage effluent into the Credit River and Etobicoke Creek and concentrating treatment at the two main plants on Lake Ontario at Lakeview and Clarkson.

Small upstream plants were eliminated, namely Erindale and Streetsville on the Credit River system and Dixie, Brampton and the Brampton/Chinguacousy Plant on the Etobicoke Creek.

Two treatment plants now treat the wastes. The West Trunk Sewer serving the western areas of Mississauga and Brampton, flows to the Clarkson Water Pollution Control Plant. The Lakeview Water Pollution Control Plant is served by the East Trunk Sewer which takes flows from the eastern areas of Mississauga and Brampton and the southwest area of Metropolitan Toronto.

All acceptance points except those in Mississauga were metered by the OWRC (now MOE) and charged at an agreed rate per thousand gallons to the municipality. In Mississauga, the flow charges were based on meter readings at the water pollution control plants, less the flow metered from the other municipalities. This method was eliminated in 1977 and replaced by a flat rate based on amortized capital debt and operating costs. Only Metro Toronto is billed on metered flow at present.

Storm sewers play no part in the design of this system and municipalities were expected to deal with storm sewers themselves.

Overall concept plus design of the West Trunk Sewer was done by Canadian-British Engineering Consultants Limited, while the East Trunk Sewer south of Dundas Highway, was designed by Marshall Macklin & Monaghan. The East Trunk Sewer, north to Steeles Avenue was designed by Proctor & Redfern while the Chinguacousy Branch was designed by Canadian Mitchell Associates. Enlargements to the Lakeview and Clarkson Plants were designed by Gore & Storrie Ltd.

Lakeview Water Pollution Control Plant

Several important pioneering developments took place at Lakeview Water Pollution Control Plant which is the largest of two regional plants serving the Region of Peel. Gore & Storrie Limited has been involved with the design of the Lakeview plant since the original 22.5 ML/D (5 MIGD) plant was commissioned in 1957.

Currently Lakeview is designed to provide complete primary and secondary treatment for 280 ML/D (62.5 MIGD). Complete sludge treatment is also provided on site.

At this plant, five significant advances in Canadian waste treatment took place. The plant was the first in Canada to employ centrifuges without the addition of polymer to thicken the waste activated sludges. Dewatered solids of 42 percent are consistently obtained, without the use of polymer. It was also the first pollution control plant in Canada to employ thermal sludge conditioning, in dewatering sludge to a fairly dry consistency, making it readily combustible.

A second extension, costing $36 million, was completed early in 1982 and incorporated a thermal oxidation process, consisting of fluidized bed incinerators with waste heat recovery. Lakeview became the first treatment plant in Canada to employ a closed-loop fuel system. By burning dried sludge, the process requires virtually no additional fuel to sustain incineration and the heat generated is converted to steam for both the thermal conditioning process, as well as to heat the buildings.

In 1984, a new rectangular final settling tank at the Lakeview Water Pollution Control Plant began to utilize two mobile siphon sludge bridge collectors operating in conjunction with a central stationary siphon sludge system. The project was the largest of its kind in Canada when completed. The stationary siphon sludge removal system utilizes the sludge density current phenomenon to provide rapid activated sludge return. The siphon rate of the bridge and the stationary system will be controlled by a sludge level monitoring system. This in turn controls the return sludge rate to the aeration tanks. The bridges are programmed on a timed basis to optimize sludge removal. In 1985, Lakeview was scheduled to put in operation Canada's first anaerobic packed bed reactor for treating high strength thermal conditioning wastes.

Located in Peel Region, just west of Metropolitan Toronto, the facility is operated by the Ontario Ministry of the Environment.

York-Durham System

The York-Durham Sewage System, completed in 1984, is one of the largest, single sewage collection and treatment systems in Canada. Serving several political jurisdictions, it is designed to have an ultimate average daily flow of about 8.42 m^3/s (160 MIGD).

The project began after the Ontario Water Resources Commission commissioned a number of studies in the late 1960's, in order to provide an integrated sewage collection and treatment system for the York and Durham Regions. In late 1972, James F. MacLaren Limited was appointed prime consultant to co-ordinate the collection component of the new system.

For the initial period, additional sewage capacity was provided by the interim expansion of several existing, upstream treatment plants and temporary connections to the Metropolitan Toronto sewage system. Subsequently, the planning, design and construction of the major trunk followed in a staged program, progressing from the Duffin Creek area at the south end of Pickering, through the population centres at the south-west section of the Durham Region, to the major growth areas in the Regional Municipality of York. The treatment component of the system is the **Duffin Creek Pollution Control Centre**, located on the shores of Lake Ontario, a few miles east of Metro Toronto. The design and construction supervision was carried out by The Proctor and Redfern Group.

The scope of the York-Durham project was staggering, involving many consulting engineering firms and scores of contractors. This system provides an integrated collection system for Woodbridge, Maple, the Thornhill-Vaughan community, Richmond Hill, Oak Ridges, Unionville, Markham, Aurora and Newmarket, within the Regional Municipality of York. It performs the same collection function for Pickering, Pickering Village, North Pickering and Ajax, in the Regional Municipality of Durham.

Designed to facilitate the orderly, planned development of existing and new communities, the new system replaced a number of low-volume, upstream sewage treatment plants and will take many thousands of households off septic tanks. It is expected that the system will serve approximately 457,000 residents in York and some 424,000 in Durham. As well, it will provide sewage collection service for 6,880 hectares (17,000 acres) of industrial land.

In total, some 132 kilometres (82.3 miles) of 900 mm (33 inch) to 3,000 mm (120 inch) diameter trunk sewers have been installed. As well, two existing pumping stations were enlarged and seven new ones constructed, with their required forcemains.

Provisional estimates put the cost of the York-Durham Sewage System in excess of $300 million. This figure includes both the collection system and the Duffin Creek Pollution Control Centre.

Consulting engineering firms who have worked on the 82 mile trunk sewer and pumping stations include:

Albery Pullerits Dickson
CBCL Ltd.
Chisholm, Fleming Associates
Cole Sherman
DeLCan
Giffels Davis and Jorgensen
Gore and Storrie Limited
J. D. Reid and Associates Limited
MacLaren Engineers, Planners and Scientists Inc.
The Kleinfeldt Group
Knox Martin Kretch Ltd.
Maksymec and Associates Limited
M. M. Dillon Ltd.
Marshall Macklin Monaghan Ltd.
McCormick Rankin and Associates Ltd.
R. V. Anderson Associates Ltd.
Simcoe Engineering Ltd.

Totten Sims Hubicki Associates Ltd.
Underwood McLellan and Associates Ltd.

The **Duffin Creek Pollution Control Centre** began to provide partial service in late 1979, with sludge incineration capability provided in 1981. Future expansion of the plant will occur to keep pace with the anticipated increase in sewage flow from the York-Durham System up to and beyond the year 1986.

In 1984, work began on the installation of four membrane sludge presses at the Duffin Creek Pollution Contol Centre which were expected to realize savings of up to $800,000 annually in energy costs. The installation will cost some $1.5-1.7 million, but the energy savings are expected to recoup the capital costs in about two years. Although membrane presses are well known in the UK and Europe, the Duffin Creek installation is the first in North America.

The presses will use polymers in the dewatering process instead of the more traditional lime and ferric chloride. A dewatered cake, having up to 40% solids, is anticipated. This will enable the sludge to be incinerated 'autogenously', that is without the use of supplementary fuel. Four presses will work on a batch system, giving a design capacity of 600 m^3 per day, with a maximum of 800 m^3 per day.

Sludge holding bins and staggered process times will provide a constant fuel supply for the incinerators at the Duffin Creek facility. The plant's incineration system uses a fluidized-bed process which, in 1984, was believed to be the largest operational municipal installation of its kind in the world.

Walden Sewage Treatment Plant

When Thoreau wrote his utopian work "Walden" while seeking refuge from the growing population of New England in the 19th century, he could not have known that his nature retreat would be an appropriate namesake for a project in Northern Ontario. The planning, design and construction of the Walden Sewage Treatment Plant in the Regional Municipality of Sudbury had unusual features; the financing by three levels of government and its effect on tender scheduling, a waste sludge thickening procedure developed by Regional Operations personnel, and the use of air-supported domes to protect final settling tanks from adverse weather.

The decision to construct the Walden Sewage Treatment Plant grew out of recommendations made in a Regional Sewerage Master Plan study by MacLaren Engineers Inc. in 1979.

Most of the contribution was domestic waste, but the plant also served a new industrial area of light industry and service establishments. It was determined that the initial plant design should be for 4200 m^3/d of flow with 104 mg/L BOD and 117 mg/L suspended solids, serving a population of 3600 people.

Waste activated sludge from the process is stored and thickened in a conical sludge holding tank which is totally enclosed to minimize odours. The thickening process was developed by Regional staff at their Kelly Lake plant.

A unique feature of the plant is the use of air-supported domes over each of the sedimentation tanks similar to those commonly seen over tennis courts and other athletic facilities. They prevent cold weather operating problems which cause havoc with scum skimmer arms and other equipment in northern areas. Use of these domes at this sewage treatment plant is believed to have been a first in Ontario. Provision was also made to ensure satisfactory winter operation of the grit classifier by the use of a cover and heat tracing of the inclined grit pan.

Nitrification Treatment

A number of plants in Ontario have employed nitrification treatment since the late seventies, including Guelph, as designed by Gore & Storrie, and Milton, as designed by R. V. Anderson Associates. Extended aeration plants normally have, by the nature of their treatment process, what could be termed a nitrified effluent.

Nitrification is a biological process which can be accomplished as a single sludge system (Milton) or a two sludge system (Guelph). In the case of a single sludge system, the activated sludge process proceeds in a common tank with nitrification. Bacteria from both processes co-exist in the same sludge. Using Guelph as an example, the activated sludge process precedes the nitrification process which is accomplished using RBCs.

Nitrification is dependent upon temperature, proper bacteria and sufficient oxygen. In most activated sludge plants, some nitrification takes place. Surplus oxygen is utilized by the bacteria to nitrify. Temperature is the controlling element inasmuch that, under colder temperatures, the bacteria grow more slowly and unless there is tank capacity to provide sufficient hydraulic retention time, the process is not completed. This constraint in fact caused the earlier plants to have two operating limits for nitrification e.g. 2.5 mg/L total ammonia in the summer and "best possible treatment" in winter.

Nitrification essentially changes the NH_3 ammonia molecule to NO_3 nitrate which is stable and is not toxic to fish.

Guelph Uses RBCs for Nutrient Removal

Guelph has been cited as a community which has always been progressive in its attitude to wastewater treatment. The original primary wastewater treatment plant was constructed about 1900 and subsequently enlarged and modified. Around 1920, the plant was converted to the activated sludge process, thus making it one of the earliest of such plants. In 1934, 1959 and 1972, the plant was again enlarged.

An innovative nitrification process, using Rotating Biological Contactors, was the largest of its type in the world when it was opened in Guelph, Ontario, in September 1980. The project, designed by Gore and Storrie Limited, was an extension to Guelph's 55 megalitre per day pollution control plant.

The most unusual aspect of this new plant extension is the method of ammonia conversion to nitrates. Using 32 Rotating Biological Contactors, ammonia conversion is achieved during the biological purification process. Napier-Reid Limited supplied the RBCs.

This process is followed by filtration of the nitrified effluent. This polishes and improves the effluent even further, by reducing the BOD and phosphorus by an additional 50 percent, compared with normal secondary treatment plant effluent values.

The Rotating Biological Contactors use approximately 50 percent less electrical energy than a conventional activated sludge plant of equal capacity, and they require less space. The facility also incorporates waste heat recovery systems which save additional energy during the operation of the facility.

The process, in addition to the normal biological sewage treatment, oxidizes some 90 percent of the ammonia nitrogen. It also removes about 50 percent of the phosphorus, formerly entering the low-flow receiving stream for the treated effluent.

Milton Uses Single Stage Sludge System for Nitrification

Increasing emphasis on water quality characteristics of receiving streams often governs effluent requirements of pollution control plants. Sixteen Mile Creek played a major role in the development of effluent criteria for the 1978 expansion program of the Regional Municipality of Halton's Milton treatment plant.

Due to the sensitive nature of Sixteen Mile Creek, and on the basis of a proposed average daily plant flow of 12 910 m^3/day, the Ontario Ministry of the Environment imposed the following effluent parameters:

- BOD_5 of 4.2 mg/L or 55 kg/day
- Phosphorus of 0.43 mg/L or 5.5 kg/day
- Chlorine residual of 0.08 mg/L
- Nitrification 90% during warm weather.

In 1949, the original water pollution control plant for the Town of Milton first began operation with a treatment capacity of 772 cubic meters per day (m^3/d). Subsequent extensions in 1958, 1966 and 1973 increased plant capacity to 7 176 m^3/d. Further growth in the town resulted in a further extension in 1978 to increase treatment capacity to 12 910 m^3/d.

The plant incorporates the activated sludge process for secondary treatment preceded by inlet screening, grit removal and primary settling. In addition, effluent filtration, chlorination, dechlorination and phosphorus removal are provided. Sludge treatment facilities consist of 2-stage anaerobic digestion for primary sludges and a multi-stage aerated sludge system with sludge thickening for all waste activated sludges.

The aeration tanks, forming part of the 1978 expansion and which account for 61% of total plant capacity, were fitted with mechanical aerators. Draft-tube units, which are characteristically sensitive to water level variations relative to oxygen transfer and power consumption, were considered to offer an optimum degree of flexibility for the nitrification process. The new aeration tank configuration permits the system to be operated on the "plug flow" or "complete mix" principle.

The aerators were designed to satisfy nitrogenous and carbonaceous oxygen demand. The detention time is 10 hours at design flow exclusive of return sludge. SRT is 10 days.

Based on alkalinity loss of approximately 7 mg/L per mg of ammonia nitrogen oxidized, the buffering capacity of the wastewater was considered adequate to sustain the required pH level for nitrification.

The new final clarifiers as part of the 1978 expansion have "rapid sludge" removal capability. Due to site restrictions and in order to maximize the use of common wall construction, square type clarifiers with scum removal facilities were constructed.

The plant incorporates a chemical feed system for phosphorus removal.

With an effluent objective of 4.2 mg/L BOD and 0.43 mg/L phosphorus. The nitrified secondary effluent is introduced to a tertiary deep bed filter system consisting of a layer of anthracite to a depth of 450 mm followed by a sand layer of 300 mm depth.

Immediately downstream from the filter system, the effluent passes through a parshall flume to the chlorine contact tank.

In order to provide a minimum chlorine residual of 0.5 mg/L for pathogenic disinfection but at the same time meet a maximum residual objective of 0.08 mg/L to the receiving stream, sulfur dioxide solution is introduced at the outlet of the chlorine tank for dechlorination purposes. The dechlorination facilities at the Milton plant are thought to be a "first" for a municipal secondary treatment facility in Ontario. An effluent contact chamber provides approximately 2.5 minutes detention at design flow and is equipped with a propeller-type mixer and inlet/outlet baffling to ensure optimum mixing of the sulfur dioxide solution.

Due to the limited capacity of the existing 2-stage anaerobic digesters, which employ gas mixing, and available land restraints, the 1978 expansion employed a separate aerobic stabilization system for all waste activated sludges, thereby utilizing existing tanks.

The aerobic sludge is concentrated in circular sludge thickening tanks prior to truck disposal.

Construction took place over a period of approximately 15 months at a total cost of $2,831,000.00.

Denitrification Treatment

Denitrification can be accomplished at laboratory scale in a number of ways, including single and double sludge systems, predenitrification, post-denitrification and attached growth systems. All systems require anoxic (zero dissolved oxygen) treatment for nitrate conversion to nitrogen gas.

Post denitrification has been applied at a number of plants in the United States, but has been found to be economically impractical at operating scale. The post denitrification design requires the use of methanol as a carbon source as this process treats conventional

secondary effluent which is devoid of carbon. The cost of methanol became too high after these plants were constructed.

A number of other processes have been applied and proven at plant scale. These are, generally, single sludge processes which use the carbon in the raw sewage to provide for the growth of denitrifying bacteria. Processes such as the Bardenpho (Kelowna, B.C.) and the Air Products - A/O Process (Largo, Florida) perform the denitrification function. They were, however, developed primarily to provide biological phosphorus removal. Denitrification, in the case of Largo, is not a full-time operating mode because of the effluent requirements.

Triton Engineering Services Limited, Consulting Engineers, recently completed a unique denitrification process project at the **Orangeville Treatment Plant.** An activated sludge plant was first constructed in Orangeville around 1929, making it one of the first plants in Ontario to use the process.

The process at Orangeville is similar to the Largo and Kelowna plants inasmuch as it uses a single sludge predenitrification process. The phosphorus constraint in the effluent precludes the biological process and the more common chemical phosphorus removal is used (alum addition).

Basically the raw sewage enters into a mixed denitrification tank. This tank also receives the nitrified mixed liquor from the aeration tank and the return sludge from the final clarifier, both of which provide bacteria and nitrate. By allowing the process in this tank to operate at zero dissolved oxygen, the bacteria utilize the oxygen in the NO_3 molecule in addition to the carbon in the sewage. Once the oxygen is removed from the NO_3 molecule, nitrogen gas (N_2) is released to the atmosphere. BOD is also utilized by the growing bacteria. The end result is that raw sewage, with ammonia and little or no BOD remaining, enters the aeration tank where the ammonia is nitrified to produce NO_3 and the residual BOD is treated in the conventional fashion.

Mixed liquor return pumps are located in the aeration tank and return nitrified mixed liquor to the denitrification tank at rates up to 4 times average day flow. Effluent from the aeration tank enters final clarifiers in the normal fashion. The clarifiers employ rapid sludge removal to reduce denitrification (sludge bulking) in the clarifiers and scum skimmers to catch any floating sludge.

Process constraints include temperature, the ratio of carbon to nitrogen in the raw sewage, and the amount of dissolved oxygen entering the denitrification process. The Orangeville design addresses each of these constraints in ways that may not apply exactly to other plants. No methanol is being used.

The denitrification process is basically a natural process which occurs in rivers. By forcing the process to occur in the plant, the nitrogen nutrient and the toxic ammonia are both partially or totally removed from the effluent.

It is fitting that one of Ontario's oldest activated sludge plants is also one of the first to use this advanced treatment technology.

Extended Aeration Project

Not all innovative technology stems from designing large scale projects. Sometimes environmental engineers are required to assist clients with serious, but small-scale problems. In 1958, R. V. Anderson Associates Limited were retained to deal with a serious wastewater problem.

The client operated one of the first gasoline/restaurant service centres constructed at a major interchange of a four-lane highway.

Located well away from urban sewerage facilities, the large service centre was situated at the south-east corner of Highway 400 and King Side Road. In addition to the considerable high strength wastes from the high volume restaurant operation, the project had to cope with shock loadings from thousands of people using the facilities during holiday weekends. Commercially, the location was ideal as a service facility, but it posed serious problems in satisfactorily treating its wastewater. A large septic tank was considered, but then rejected, because of the extremely large tile bed area required.

The engineers decided the solution would be to install a 20,000 IGD extended aeration plant. At the time this was a bold, pioneering move and engineers at the Ontario Water Resources Commission were dubious about the proposal. Not only was the process unproven, but they noted that the treatment facilities would not be operated under municipal jurisdiction.

The engineers prevailed and Dr. Berry, then OWRC General Manager and Chief Engineer, granted the project OWRC approval, subject to certain conditions. The result is thought to be Ontario's first extended aeration wastewater treatment facility.

Many problems had to be overcome before operational success was achieved. For one thing, there were no base statistics to judge the nature of flows to the plant. The engineers spent many long hours physically counting the number of people using the centre's facilities (the service centre initially had holding tanks). The number of meals served, and other vital data were collected, on a per hour, per day, per week and per month basis. Heavy shock loads were a major factor as well.

Wastewater flows were channeled first to a comminutor, which shredded the waste before it entered the aeration tank. It was mixed in the aeration basin for 24 hours, then held in the final settling tank for about four hours before disinfection with chlorine. Chlorinated effluent was flushed through a dosing siphon to a 40 by 45 foot underground filter bed, through which it percolated. An underdrain system collected the purified waste for eventual discharge to the headwaters of the Humber River.

Effluent quality was high enough that the extra capacity, originally allowed for in the expansion of the filter bed, was never needed. The longer aeration time meant that sludge settling out in the final settling tank was already well digested, eliminating the need for a separate sludge digestion tank. Stored sludge was pumped once or twice per year from an on-site storage tank to a tank truck for land disposal. Long retention times could have led to some surface freezing problems in

the final settling tank, but this problem was solved by covering the tanks.

The system served its purpose well, operating for the full term of the centre's 20-year lease on the property. The pioneering sanitary engineering project was levelled and the site is now a commuter parking lot. But further up the highway, a similar plant continues to operate. The original extended aeration plant proved a practical and economical sewage treatment alternative.

Today, few commuters realize that they are parking their cars on a site of historical significance to the environmental engineering fraternity.

Ajax - a Conversion Project Approved, then Abandoned

In 1980, Simcoe Engineering Limited, then relative newcomers in the consulting field, was responsible for a milestone in industrial waste treatment. In that year, the Region of Durham brought before the Environmental Assessment Board, its proposal to convert the Ajax sewage treatment plant into a liquid industrial waste treatment facility. A Public Hearing followed, which lasted six months, and the Environmental Assessment Board recommended approval of the project. This decision became controversial and, at the political level in Durham, it was decided to withdraw the application for approval, and not to proceed with the project, which had been the first of its type to be approved by way of the Public Hearing process. It is interesting to reflect that, despite enormous expenditures of public funds, the opposition to industrial waste treatment plants is no less intense and there is no specific proposal for a facility to be built.

The Ajax project was initiated when Simcoe Engineering Limited submitted an unsolicited proposal to the Region of Durham, and later to Supply & Services Canada, to study the feasibility of converting the redundant sewage plant into a liquid industrial waste treatment plant. That study concluded that the project would be both feasible and economical. It was evident that there were substantial quantities of industrial wastes within a 100 km radius of the facility, including of course, those generated in the Region itself.

It was decided to limit the types of wastes to be treated to waste acids and alkalies, oxidizing wastes, aqueous oily waters and cyanide wastes. The existing plant lent itself to ready adaptation for the treatment of wastes of these types, and market research indicated that there would be adequate quantities available to make the plant worthwhile. The plant was to have a capacity of 8.8 million gallons per year, which was about 12% of the, then, current estimate for the volume of liquid industrial waste being generated in the Province of Ontario. The processes were relatively simple and they included: oxidation/reduction, neutralization, settling/separation and air flotation, depending, of course, on the waste streams to be treated. All of the waste streams were to be brought together prior to both sand filtration and carbon adsorption. The final effluent would have been passed to one of two holding tanks, with a detention time of 10 days to permit detailed final analysis prior to discharge to the adjacent municipal sewer. The effluent would have complied with the municipal by-law for discharges to the municipal system, and it would have received further treatment at the Duffin Creek Pollution Control Centre.

Extensive measures were proposed to provide a short and controlled trucking route from the nearby Highway 401, and to deal with accidents and spills. The facility would have included a new waste-holding area with provision for analysis of wastes, both prior to acceptance at the facility, and also prior to treatment.

Extensive efforts were made by the Region to bring the project to the public's attention for a period of almost two years. These efforts included a public information program with an "Open House" in a shopping mall in Ajax. Just prior to the public hearing, the project ran into fierce opposition from a local citizens' group, who in the opinion of the project staff, misunderstood the proposal.

The Ajax project received wide publicity in the news media, and it was the subject of many technical papers, including presentations by Tom Fowle, President of Simcoe Engineering Limited, at the Third National Conference on Waste Management, and the 28th Ontario Industrial Waste Conference.

The company, however, acquired a great deal of valuable experience in the industrial waste treatment field, public information programs and first-hand exposure to hostile citizens' movements.

For the Simcoe organization, it was a setback not to see the project come to fruition, even though the proposal was a technical success.

John Street Sewage Treatment Plant

The John Street Sewage Treatment Plant in the Township of Markham was the child of the explosive land development boom that hit Metropolitan Toronto and the adjoining areas in the 1960's. The plant, which was located close to a prestigious Thornhill residential development, was constructed and commissioned in 1966, with the works being fully financed by a land developer; after commissioning, the works were "sold" to the Township for one dollar, with the Township taking over the responsibility for operation and maintenance.

The treatment plant, which was engineered by Proctor & Redfern Limited, had a rated capacity of 0.75 IMGD. Its location demanded that not only would the plant be attractive in appearance and not detract from the pleasantness of its surroundings, but be capable of producing an effluent of a quality adequate for discharging into the meagre flow of the west branch of the Credit River. The plant gave treatment by the activated sludge process with the secondary effluent being polished by sand filtration prior to discharge.

The plant incorporated two "firsts":

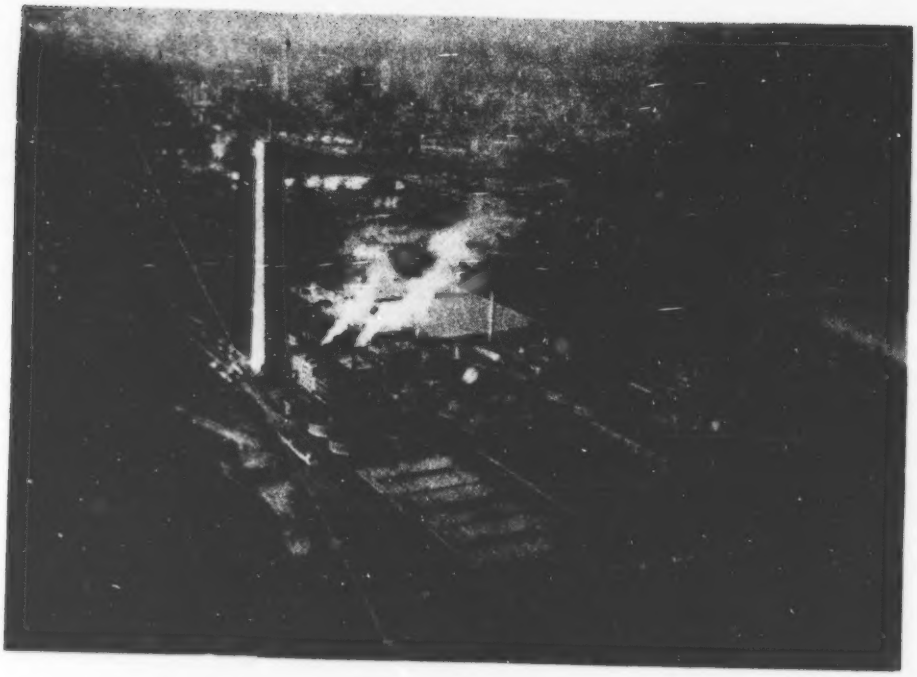
- the first plant in Canada to use the Inka system of aeration in the aeration tanks of the activated sludge process

- the first plant to do effluent polishing by means of a low-head automatic backwash filter.

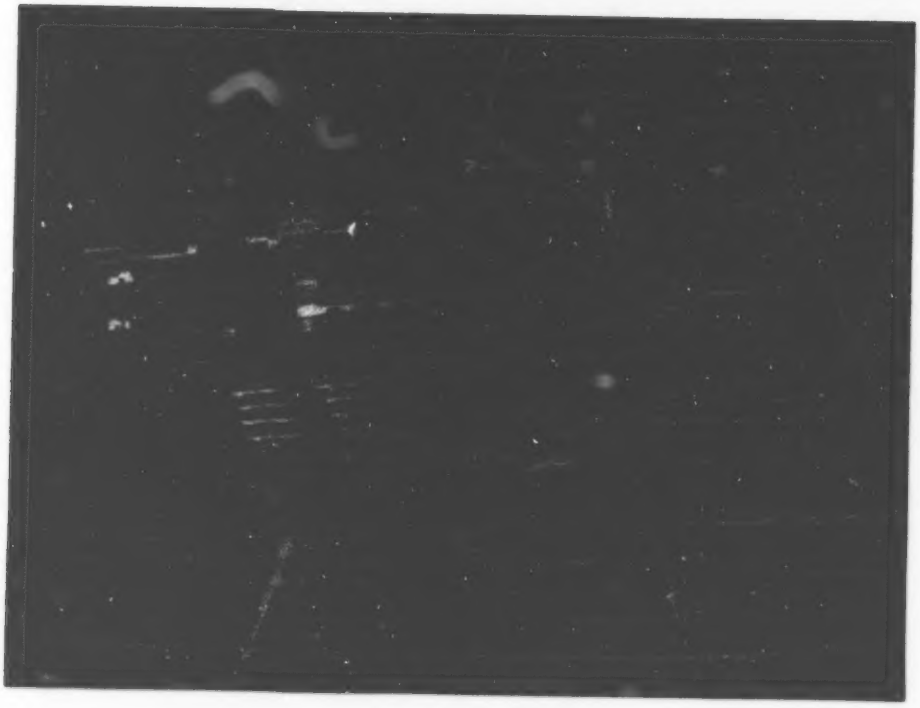
The Inka system of aeration makes use of copious quantities of low pressure air rather than the conventional lesser quantities of medium pressure air. With the Inka system, simple fans rather than blowers are

used for air generation. Low-head automatic backwash filters previously had been used in water treatment; this was the plant to initiate their use for effluent polishing, a use that is well accepted today.

John Street sewage treatment plant is no more. It was taken out of service in 1983 when the sewage from the area was taken into the York-Durham system for treatment at the Duffin Creek Pollution Control Centre.



Metropolitan Toronto, Main Treatment Plant.

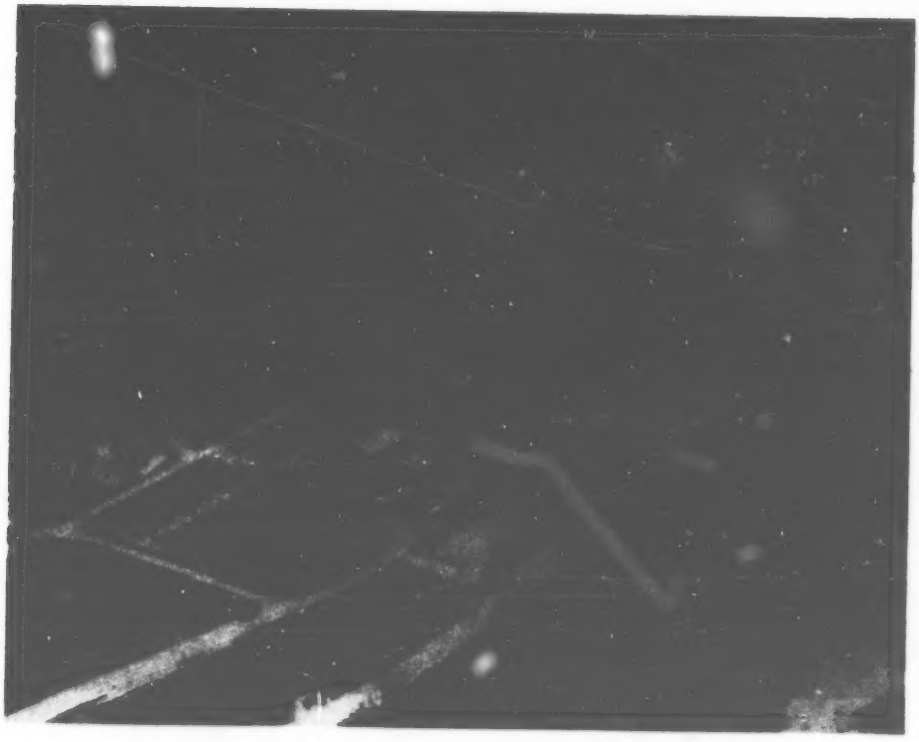


Duffin Creek Water Pollution Control Plant, 1984.

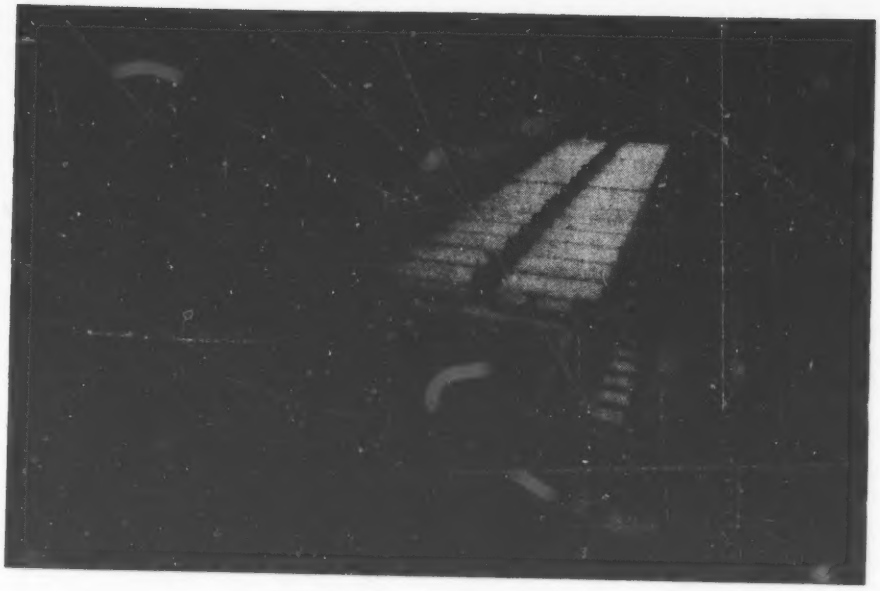
Humber Water Pollution Control Plant.

Highland Creek Water Pollution Control Plant, 1984.

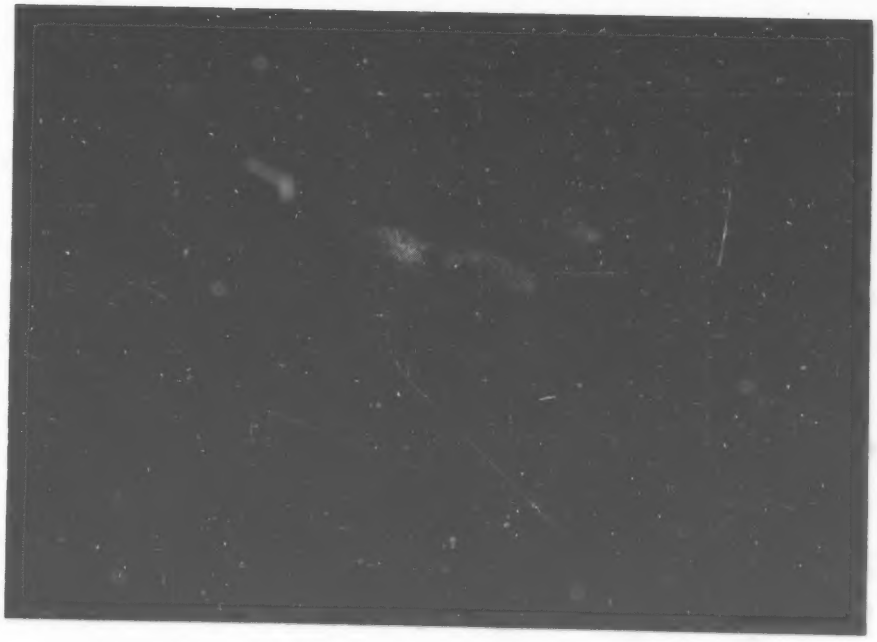
Hamilton Water Pollution Control Plant, 1979.



London Greenway Treatment Plant.



RBCs at Guelph.



Walden Treatment Plant.

(h) Industrial Water Pollution Control Facilities

The Rapson/Reeve Process

A quantum leap forward in industrial pollution abatement took place in the early '70s with the development of the Rapson/Reeve closed-cycle pulp mill. Although this was really a high-tech manufacturing operation, rather than a pollution abatement process, the Rapson/Reeve System made a significant contribution to pollution abatement in what has traditionally been a large volume polluting industry. What is interesting here is the integrated approach, where the sheer efficiency of the manufacturing process virtually eliminates wastewater pollution. Due to high chemical consumption, the system is not a 100 percent closed loop, but the substantial decrease in pollution has made the process a world-renowned example of Ontario developed technology.

The successful operation of the closed cycle pulp mill at Great Lakes Forest Products Limited in Thunder Bay, Ontario, is enormously significant on several counts. Conceived by Canadian scientists, Dr. Howard Rapson and Dr. Douglas Reeve, its operational performance demonstrates that economic viability and strict ecological standards are indeed compatible. This is a remarkable achievement for a pioneer venture involving so many complex processes and engineering and manufacturing factors.

The system was developed by ERCO Envirotech Ltd., a joint venture company formed by ERCO Industries Limited and the Envirotech Corporation.

The Rapson/Reeve closed-cycle process eliminates polluted discharges through internal recycling, something which has been advocated for years. No waste treatment outside the plant is required, as only thermally-enriched discharges enter the receiving waters. Moreover, the recycling technique achieves full recovery of all fibres, chemicals, organics and heat. As many of these materials have an economic value, this recovery gives a monetary return, while removing a serious source of pollution in the receiving water.

As a final bonus in this energy-conscious age, raw water usage and energy consumption are low.

In the closed-cycle mill design, bleach plant effluent is recycled to the liquor preparation area and brown stock washing after proper pH adjustment.

Chlorine use is cut dramatically by the substitution of some 70 percent of equivalent chlorine dioxide. This improves pulp yield, strength and brightness stability.

Contamination resulting from heavy metal ions and silica is controlled during recycling by their removal in the dregs and grits discharged during recausticizing.

Wherever possible, heavily contaminated condensates are used as dilution liquid in the unbleached stages of the process, with remaining contaminated condensates steam-stripped to remove volatile materials which are incinerated. Treated condensates are recycled for further use.

Salt recovery is a major innovation. The Salt Recovery Process invented by Professors Reeve and Rapson (SRP is an ERCO Envirotech Ltd. trademark) removes sodium chloride from the pulp mill circuit introduced through the recovery of bleaching effluent. NaCl buildup is controlled and maintained at a reasonable operating level. This process also makes a large supply of quality salt available for use in the manufacture of bleaching chemicals.

Financial backing from both the Federal government and the Province of Ontario was a vital component.

But there is a lesson to be learned for those who would use this successful application of science and technology as a lever to exert further pressure on older mills with poor environmental records. The fact is that many old mills are a labyrinth of pipes and sewers which would make effective closed-cycle processing virtually impossible. However, parts of the new process have been adopted by many older mills.

Stelco

Stelco Inc. is Canada's largest steel company, with the capacity to produce 6,900,000 metric tonnes of raw steel per year. It has 20 manufacturing plants spread across Canada, the main basic steelmaking plants being Hilton Works in Hamilton, Ontario (capacity 5,250,000 metric tonnes per year) and Lake Erie Works near Port Dover (capacity 1,150,000 metric tonnes per year).

This company has an extensive program of water pollution control and has spent $142 million in its efforts since 1960. It has pioneered treatment systems in several areas of water pollution control.

In 1965, Stelco Inc. brought into operation the first large-scale acid regeneration facility, combined with the use of hydrochloric acid for cleaning steel.

The surface of steel has to be cleaned of oxide prior to further processing such as galvanizing. Historically, this cleaning operation had been carried out using sulfuric acid which breaks away the combined surface scale to produce a clean surface. However, as the acid became depleted, a bath of weak acid was produced with significant iron content and it had to be discarded as a waste.

With this installation, a significant improvement was made in environmental control. A potential waste product was recycled (approximately 90,000 gallons per day) and a valuable by-product in the form of iron oxide was developed for use in products such as magnetic tape.

In 1972, an oily wastewater collection system and treatment plant was completed at Hilton Works. This facility permitted not only the separation of oil from water but also purified the oil for use as a fuel. This pioneering step for the steel industry permits the recovery of approximately 800,000 gallons of oil per year.

In 1974, Stelco brought into operation an Ion Exchange Plant for the removal of chrome from the rinse waters from the tin plating operation. The final step in the production of tin coated steel for use as food and beverage containers involves the application of chrome brightener to the

tin surface. Inevitably, some chrome is carried over into the rinse water.

This installation was an adaption of known technology in another field to this particular use and was a solution to an environmental problem in the steel industry. In addition, it permitted the recycle of rinse water and offered the possibility to recycle the recovered chrome product as well. This application was a first in the Canadian steel industry.

In 1980, Stelco Inc. opened a new basic steel plant, called Lake Erie Works, on the north shore of Lake Erie. Traditionally, basic steel plants have discharged between 20,000 and 30,000 gallons of water for each ton of steel produced. The majority of this water, of course, has been used strictly for cooling purposes. At this new steel plant, both the water which comes in contact with steel in process and the clean cooling water are recycled and reused several times. As a result, less than 2,000 gallons per ton of steel produced are discharged to the watercourse.

In addition to water recycle, state-of-the-art technology is applied for cleaning water which is discharged at this plant. Extensive systems of backup facilities, including spare equipment and temporary holding lagoons, are available to handle outages of equipment or malfunctions. Separate sewer systems are provided for storm water, sanitary sewage and process water to ensure proper treatment of each. The result of all these features, especially the water recycle, is that the effect on receiving waters has been minimized. This is the first integrated steel plant to employ such a high degree of water recycle in all of its operations.

Water Pollution Control at Dofasco

Dofasco became an integrated steel company, installing coke ovens and a blast furnace in Hamilton, Ontario in 1951. One of the first major water pollution control installations was a 100-foot diameter clarifier and associated dewatering facilities installed in 1956 to settle suspended solids from the blast furnaces. Another significant water pollution abatement step was the shipment, in the '50s and '60s, of Dofasco's waste pickle liquor to a chemical company for neutralization. By 1960, a system for clarification of Cold Rolling oils had been installed.

A comprehensive two phase plan for control of Dofasco's wastewater discharges was outlined to the Ontario Water Resources Commission in a letter dated 1963. The first part was a "short range five year programme to eliminate major sources of pollution." The second part was described as a "longer range programme aimed at ultimately eliminating all sources of pollution and preventing new sources of pollution."

Major installations under the first phase included:

1965 - larger scale pits for settling solids in the Hot Rolling Division

1966 - Cold Mill oil removal systems

1967 - 135 foot diameter clarifier for settling Steelmaking scrubber solids

- primary settling and secondary biological-activated sludge treatment of Coke Plant wastewaters

- conversion of once-through cooling of Coke Oven gas to closed circuit cooling and chemical recovery for ammonia, hydrogen cyanide and hydrogen sulphide from Coke Oven gas.

Major installations under the second phase included:

1971 - Ammonia Still for stripping ammonia from Coke Plant wastewater prior to activated sludge plant

- 20,000 gpm capacity Hot Mill Deep Bed Filtration Plant

- HCl Acid Regeneration Plant

1974 - Cold Mill Wastewater Treatment Plant for breaking Cold Rolling oil emulsions and treating all contaminated Cold Finishing solutions.

Expenditures for the first phase were $6,700,000, while expenditures for the second phase totalled $53,000,000 to the end of 1975.

Over the period of 1975 to 1981 the following water pollution control systems were installed:

- Zimpro Wet Oxidation Plant for treatment of Coke Plant wastewaters
- Silicon Plant Clarifier
- larger Blast Furnace Clarifier
- larger Steelmaking Clarifier.

Modifications were carried out at the following installations to increase treatment capacity and/or improve treatment efficiency:

- Coke Production Ammonium Sulphate Plant
- Ammonia Still - Biological Plant
- Hot Mill Filtration Plant.

Capital costs for water pollution equipment for the period of 1976 to 1981 are estimated at over $30 million. In 1981, operating and amortization costs for water pollution abatement at Dofasco were estimated at $14 million.

During the period 1966 through 1981, the company reduced its water pollutant emissions in the range from 75 to 98%, depending on the pollutant.

General Motors Adopts a Wastewater Precleaning Alternative

The wastewater treatment facility at General Motors of Canada's plant in St. Catharines, Ontario, handles all wastewater from the plant, with the

exception of sanitary waste. This amounts to over 17,000,000 gallons a day.

The solids content of this water is high in grit and abrasive material, being approximately 27% sand and iron filings.

The grit that found its way into the water was causing severe wear and stoppages in the system's piping, pumps, clarifiers and other components. According to project engineer, Gary Vriens, consideration was even given to using expensive glass-lined pipe.

To remedy the costly replacement of this equipment and accompanying shutdowns, as well as to ensure a properly operating wastewater system, GM engineers and consulting engineers, M. M. Dillon Ltd., considered several methods of precleaning the wastewater before it entered the two 130 foot diameter clarifiers.

Their solution to the problem was the installation of three 72-inch diameter spiral classifiers, produced by the Denver Equipment Division of the Joy Manufacturing Company. At the time it was calculated that this would cover the plant's input with 50% backup. However, with the addition of new emissions control equipment and the resulting increase in wastewater, the backup unit was put into operation.

The spiral classifier combines settling out of solids and physical removal of larger material. It builds a bed beneath its spiral conveyor so that coarser material and tramp items can be raked up and out the top. Spiral classifiers range in size from six to 120-inch spirals, which may be single, double or triple pitch. The tanks come in a variety of designs.

The use of spiral classifiers to preclean wastewater at the plant has diminished pump and equipment maintenance problems and has improved classifier efficiency because there are fewer solids to settle.

According to Mr. Vriens, GM now meets environmental standards more easily. "Our downtime has been cut sharply," he commented, "and we're not constantly replacing eroded pumps and pipe elbows or cleaning out plugged lines. Even the belts on our vacuum belt filters last longer and we don't get the heavy solids build-up in the bottom of the filters."

GM has now covered the classifiers with an insulated enclosure and warm (24°C) air is passed over the surfaces to combat winter freeze-up possibilities.

Ontario Hydro

Ontario Hydro services over 8 million consumers of electricity in Ontario. This energy is provided by hydraulic and thermal (coal, natural gas, oil and nuclear) generating stations.

Ontario Hydro uses large volumes of water at both its hydraulic and thermal generating stations and is the largest single user of water in the province. Bruce Nuclear Generating Station B alone, a 3,000 MWe capacity station on Lake Huron is estimated to use 162,000 L/s of water, but over 90% is used for condenser cooling and should not be classified as an industrial waste.

The primary wastewater streams from thermal generating stations (in particular the fossil-fired) are as follows:

1. Boiler cleaning wastes (intermittent discharge);
2. Preheater wash (intermittent);
3. Sewage (continuous or intermittent);
4. Boiler-feed water treatment plant waste (continuous);
5. Coal pile and ash disposal site runoff (intermittent);
6. Coal ash sluicing water (intermittent); and
7. Boiler blowdown (continuous).

Wastes are treated, neutralized or settled as necessary to ensure compliance. Where practical, discharges are well below the MOE guidelines, which has typically been the operating experience in Ontario Hydro. Water reuse is becoming a common consideration at the design stage. An example of this would be the use of clarifier sludge, instead of fresh water, for dust control purposes.

Monitoring effluent quality is a continuous process and the results of these analyses are submitted to the MOE monthly by the Operations Division. Design and operation of all wastewater treatment facilities, using normally conventional methods, i.e., proven technology, are negotiated with the MOE from whom approvals are obtained under both the Environmental Assessment Act (conceptual approval) and the Environmental Protection Act (detailed design approval). Experience gained from these negotiations, and interpretation of regulatory guidelines are documented in the Project Environmental Requirements (PER's), issued to the project designers specifically for that project. These PER's specify engineering requirements that will have to be met to best comply with MOE guidelines and regulations.

The following describes briefly some of the history of development of treatment practices used by Ontario Hydro.

Boilers for steam generation have to be cleaned before commissioning and periodically after operation to remove scales, grease, etc. The waste stream contains trace metal contaminants such as Cu, Fe, Al. It is directed to a treatment pond. In the past, hydrochloric acid and phosphates were used for cleaning. However, a more manageable and environmentally acceptable method, using citric acid and ammonia, has recently been employed because the former is biodegradable and ammonia can be dissipated by aeration. The heavy metals can then be precipitated to acceptable levels and the wastewater discharged in an environmentally acceptable manner. In nuclear stations, the type of boilers permits the use of morpholine and hydrazine for cleaning. The wastes can be acceptably discharged at a controlled rate. The volume of waste for operational boiler wash is about 1,300,000 litres per wash (average of 1 wash per boiler per 4 years).

Preheaters are used to preheat air before it goes into the boiler circuit. They need to be cleaned a few times a year. The waste normally contains large amounts of heavy metals, although the volume is relatively small (about 10^7 litres per wash, 2 times per year per unit). To remove these heavy metals before discharge, pH adjustment is required. Ontario Hydro is always studying the effect of pH on various heavy metal removal processes to further reduce concentration of these contaminants before discharge.

Sanitary sewage is handled conventionally, either by municipal plants where applicable, or treated on-site with sewage lagoons or packaged plants.

Boiler-feed water treatment plants demineralize the water, using clarifiers, filters and ion exchangers. The sludge is normally landfilled, but recently it is being recycled for dust control in flyash disposal sites. Other major liquid waste streams are from the regeneration of ion exchange resins and consist of sulphuric acid, sodium hydroxide and salts such as carbonates, sulfates and chlorides of sodium and calcium. Previous treatment practice involved neutralizing these streams before discharge by the addition of chemicals to maintain an acceptable pH range of 5.5-9.5. However, this practice has been changed to avoid excessive dissolved solids loading to the Great Lakes. The policy now is to discharge this stream without treatment as long as it does not effect a net pH change of ±0.5 units in the receiving water. A 2,400 MWe station discharges about 3 L/s of water treatment plant waste.

Ash disposal site and coal pile drainage contains heavy metals from leaching. To prevent this from going to the lower water table, storage areas are lined and ditched on their borders to intercept seepage and runoff and discharge into a collecting pond. The contents are treated, if necessary, before discharge. Storage areas, not previously so designed, have been modified accordingly in recent years.

In the past, the volume of water used to sluice flyash and bottom ash was considerable (56 L/s unit for a 2,400 MWe plant consisting of 4 units) and was heavily contaminated with heavy metals. Flyash is approximately 10 times the volume of bottom ash, and is highly leachable, and therefore contains most of the heavy metals. Ontario Hydro has now turned to handling flyash on a dry basis to eliminate this source of wastewater. Removal of bottom ash by sluicing constitutes less of a problem since bottom ash is only about 10% by weight of flyash and heavy metal leachability is less.

Ontario Hydro has strict design guidelines for management and containment of hazardous materials such as dielectric fluids, hydraulic fluids and other oil and grease effluents. Another toxic chemical used is chlorine for condenser anti-fouling purposes. An optimization study is presently underway to decrease or eliminate the use of chlorine to help maintain clean condensers for efficient operation of the stations.

In summary, studies continue to be carried out, both within Ontario Hydro and in conjunction with other organizations such as Environment Canada, and Environment Ontario, The Canadian Electric Association, the Electric Power Research Institute and the US Environmental Protection Agency, to characterize liquid wastes and to provide a basis for system review and potential improvements.

Deepest Plant In Ontario

The deepest wastewater treatment plant in Ontario is almost certainly in Sudbury. It is one phase of INCO's $40-million pollution control program for the purification of mine water before it is pumped to the surface for release into natural watercourses. Part of the plant includes a huge clarification tank, 40 feet in diameter, 2200 feet underground at the Copper Cliff North mine, in which precipitated metal

salts and suspended solids settle to the bottom. The clear water overflow is channelled to underground reservoirs where it is impounded before being pumped to the surface. The settled sludge is fed to a vacuum filter, and the dry cake joins the normal ore flow from the mine. Water removed in the filtering process is recycled through the clarification tank. The system, in operation at Garson mine, was designed and installed by Inco engineers with equipment supplied by Envirotech Limited.

Polysar Biox Plant

The $25 million Biological oxidation waste treatment facility (Biox Plant) at Polysar's Sarnia plant was designed and engineered by consultants, Marshall Macklin Monaghan. The facility is designed to reduce water soluble organic pollutants, using the extended aeration biological process.

Polysar's Sarnia facilities produce synthetic rubbers, lattices, polystyrene resins and other petrochemicals. The effluents from these processes vary considerably in both flow rates and characteristics. Some of them have also been pre-treated to remove oil and rubber, which is recycled.

Based upon the variances in the streams, it was decided to size the facility for a nominal capacity of 24,500 cubic metres per day, with a peak rate of 41,500.

Major components in the Biox facility's processes include pre-treatment, pre-aeration/equalization, aeration, clarification and sludge return.

Coming into the Biox plant, the waste streams are mixed and nutrient chemicals are added; the pH is adjusted. Free oil and solids are removed and the stream goes through an equalization/pre-aeration tank to complete its pre-treatment.

The stream then goes into the aeration tanks where it is mixed with the activated sludge and dissolved oxygen to start the biological process. The microorganisms in the sludge then proceed to destroy the organic pollutants.

The aeration stage is done in four tanks. Each tank has a 6,000 cubic metre capacity. Aeration and mixing are critical to maximum performance in this process. Overall plant layout and design called for deep basin-type tanks, which were a key factor in choosing the aeration system.

After extensive evaluation, a jet-type system was chosen as the most suitable for Polysar's needs. This system is well suited for use in deep tanks. It provides a high oxygen transfer efficiency with minimal air requirement, and the jet action ensures effective mixing in the tanks. This deep tank/jet aeration configuration was the first of its kind in Canada.

Three variable diffuser vane blowers supply the air to the jet aeration system. They are housed in a separate building next to the tanks. Although these blowers have been used successfully in Europe to achieve high efficiency aeration, this is the first installation of this kind in North America.

From the aeration tanks, the stream goes to the clarifiers where the sludge solids are settled out. This is recycled back to the aeration tank and the treated water goes to the outfall and into the river.

The heart of the Biox plant is the central control building; and the heart of the central control facilities is the laboratory.

The 2,500 square foot laboratory is said to be one of the most sophisticated in the industrial waste treatment field. Much of the equipment is automated for 24 hour continuous monitoring, and the facility can perform virtually any known test procedure. It also incorporates a small pilot plant which is run on an ongoing basis.

Part of the ongoing activities to optimize the efficiency of the Biox plant is developing special strains of bugs. Polysar is working with research teams from the University of Michigan and the University of Western Ontario to develop unique strains of mutated bacteria. These are intended to oxidize some waste streams which are difficult to handle using natural selection strains, e.g. Tertiary Butyl Alcohol (TBA). The university teams develop the strains, which Polysar then run through the pilot plant. If successful, the new strain is incorporated into the actual Biox process.

Industrial scale biological waste treatment plants, such as the Polysar Biox, can have some unique control problems. Complex control interactions, large control reaction time constants and the need for long term data acquisition are among them. Polysar's approach to the required control strategies was to employ direct digital control (DDC).

All of the control strategies were designed by Polysar and their consultants, Fodor, a subsidiary of Marshall Macklin Monaghan, and were implemented by Sentrol's process engineers. The complete system has 36 control loops, 24 indicators and 270 digital points.

In addition to data acquisition and operator information, the central computer provides capabilities for strategy modification and program development. As this was something of a prototype system, it was felt strategy changes would probably be needed to optimize the plant's capabilities.

The functions handled by the control module include all the control loops normally associated with the activiated sludge process. In addition, there are some unique control strategies required by the nature of the various waste streams. One of these includes automatic pH control, with selective use of measurement elements. Full sequence control of tank valves and pumping systems is also handled by the PCM.

In addition to the major plant functions, the computer system also monitors and controls the following:

- Chemical storage tanks, levels and temperatures.
- Chemical storage tanks, electrical heating.
- Skimmed oil pumping.
- Scum chamber level measurement and pumping control.

- Plant effluent turbidity and return sludge measurement.

The Biox Plant was designed and constructed over a two-year period. A comprehensive operator training program was conducted during the final six months of construction.

The facility went on stream in December 1982. Initial operation was with two influent streams, three aeration basins and one pair of clarifiers.

Operating at 50% capacity, a TOC reduction of 50% was achieved, which was above the figure expected for that time of year. The plant was brought into full operation in four months and has been successfully meeting the design objectives since that time.

Polysar, of course, is not unmindful of the plant's potential for generating some payback on its investment. Already there have been many enquiries from other companies with similar waste streams that require treatment. Investigations into treating similar waste streams are being made and, if successful, could help to offset the annual operating costs for the Biox plant.

CHIPMAN & POWER'S PROJECTS

Cornwall, Sewerage and Waterworks, Construction, Report.
Brockville, Waterworks Improvements and Sewerage, Report, Construction.
Gananoque, Waterworks and Sewerage, Construction.
Smith's Falls, Waterworks and Sewerage Construction.
Carleton Place, Waterworks and Sewerage, Report.
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BERLIN

Sewage flow was passed through the old 60,000 gallon septic tank at the rate of 100,000 gallon per 24 hour. The inflow from the sewer outfall contained on the average, during the test extending over nearly 2.5 months, the following characteristics: free ammonia, 2.329; albuminoid ammonia, 1.93, and oxygen consumed, 54.48 parts of 100,000. The effluent from the tank contained per 100,000 parts free ammonia, 2.223; albuminoid ammonia, 1.057; oxygen consumed, 32.27. An 1,800-gallon tank, a duplicate of the large tank, was operated at the rate of 1,800 gallon a day during the same time. The results from the small tank operated at the slower rate, showed an increase of 7.5 percent, in the removal of albuminoid ammonia and 10.1 percent, increase in the removal of oxygen consuming materials, as compared with the results obtained from the larger tank at the higher rate. The outlay made in supplying more tankage capacity was considered to be repaid by the increased efficiency of the plant. The new tanks have combined capacity of 450,000 gallon and the old tank is also available for service.

Experiments were also made with four contact beds treating the effluent from the large septic tank. One of these beds has an area of 0.00125 acre, and the other three each 0.005 acre. The small bed contained 3 ft. of hard 1 in. coke, underdrained with 4 in. tile. It was run at the rate of 712,000 gallon per acre per 24 hours. The other three beds contained three feet of gravel, varying in size in the different beds, and covered with 3 in. of sand. They were run at rates varying from 374,000 to 773,000 gallons per acre per day. Three applications a day being made during part of the experiments and two a day during the remainder. At no time was the effluent from any of these beds nonputrescible. The bed with the smallest gravel always gave the best and the one with coarsest, the poorest effluent. There were no appreciable differences in the results whether two or three applications a day were made.

An excellent quality of sand was found to underlie considerable areas in the vicinity of the septic tanks, being a few inches under the surface, but it was 40 to 50 ft. above the level of the tanks. From the result of the experiments decision was made to build intermittant filter beds on these sand areas and to pump the effluent from the septic tanks to them.

The tests carried on at the factories indicated that settling tanks could be built and operated for slight expense, which would greatly improve the objectional manufacturing wastes. The system of gas manufacture has been changed to a corborated water and producer gas process in which, all by-products are utilized. The connection with the sewer has been cut off and the waste water from the gas works is turned into a natural water course. Merely screening the effluent from the brewery was found to remove the objectional material from the waste from the latter. A storage basin at the woollen factory, giving time for the settlement of the sludge and baffled at the top to remove the fats was found to serve the purpose there. With tanks having a capacity equal to the 24-hour flow from the tanneries as much as 40 percent, of the organic matter in the tannery wastes would greatly neutralize each other at the same time. Construction to achieve these results has been completed at the various factories during the building of the new disposal plant.

The two new septic tanks are each 36 x 136 ft. in plan and are built with one side wall common to both. A 36 x 150 ft. storage tank is built at the effluent end of each tank, the adjacent ends of tanks having the same wall. The four tanks have floors, and walls of concrete and are covered with groined-arch concrete roofs, carried by the walls and by piers built up from the floor. The roofs have 2 ft. of earth filling over them. A 12 x 36 ft. grit chamber is built at the inlet end of each septic tank and is separated from the latter by a concrete wall extending 12 in. above the normal level of the tanks.

The outfall sewer terminates in a brick wall from which the sewage flows to the old septic tank and to a circular screen chamber built at the inlet end of the new tanks. The screen chamber is connected to the centre of the side of each of the grit chambers by a bell-mouthed pipe submerged below the level of the sewage in the tank. The sewage flows from each grit chamber to the tank with which the latter is connected through three semi-elliptical openings in the wall between the chamber and the tank, the openings being just below the surface of the sewage in the tank. The floors of the tanks slope from the inlet end to the outlet end, the normal depth of sewage at the former being 6.5, and at the latter 7.5 ft. The outlet from each septic tank is two 18 in. half-bent pipes, with their horizontal legs through the wall separating the septic tank from the storage tank, and the end of the vertical legs submerged 4 ft. below the surface of the sewage in the former. Each of these outlet pipes is placed six feet from the side wall. Midway between them on the centre line of the tank is a pump connected through the end wall to a pump in the storge tank, by a pipe controlled by a valve operated from the surface of the fill over the tanks. Each grit chamber is also connected at the bottom to the pump in the storage tanks by 14 in. cast-iron pipe laid in the division wall between the septic tanks.

An 18 in. vitrified-clay pipe also connects the old septic tank with one of the storage tanks. A connection between the brick chamber at the end of the outfall and this 18 in. pipe enables the three septic tanks to be by-passed. And one of these tanks may also be thrown out of service.

The flow from the septic tanks is allowed to pass into the storage tanks at the rate the sewage comes from the outfall. The storage tanks will be emptied once in 24 hours. Two horizontal (Canada Foundry Co.,) turbine pumps, with a capacity of 1,000 gallon a minute, placed in a one-storey pump house built at one side of the tanks, will elevate the tank effluent through a force main to distributing chambers built in connection with the filter beds. These pumps are each direct-connected to a 90 h.p. Canada General Electric Co. three-phase, 60-cycle, revolving-field induction motor and are designed to run at 800 r.p.m. A 500 gallon per minute Canada Foundry Co. centrifugal sludge pump is belted to one of the motors, and has its suction in the sumps in the storage tank. Electric power is furnished by a 100-kw, three phase 60-cycle, 2,300 volt Canada General Electric Co., alternating current generator in the municipal power station, 1.75 miles distant. The turbine pumps operate against a total head of from 55 to 75 ft. and each pump can empty one of the storage tanks in 4 hours. A 14 in. riser main leads to the filter beds. The sludge pump discharges on sludge beds 55 ft. above the tanks.

There are 16 filter beds with a combined area of 14 acres. These beds are at various levels and are supplied by gravity from the distributing chambers one 55 and the other 75 ft. above the bottom of the sump in the storage tanks. The area in which they are built had a surface layer of loam, 6 to 20 in. thick, under which was a stratum of coarse, sharp sand of at least 20 ft. deep. The beds were formed by scraping the loam into embankments around their sides and then leveling off the sand. The excavation and embankment were practically balanced, the former being 75,793 cu. yd. and the latter 74,880 cu. yd.

The two central concrete distributing chambers are built for the 16 beds, one for those at each general level. Valves are provided on the riser main so the discharge may be diverted into either chamber. From each of these chambers 18 in. sewer pipes are laid in the embankments to a valve chamber at each end of the beds in the level served by straight embankments. A distributing channel extends across each bed from its valve chambers, the channels being laid diagonally. A concrete culvert with wing walls built in the embankment connects the distributing channel with its valve chamber. Each of these channels has a concrete bottom laid with its surface flush with the surface of the bed. The sides consist of 2 x 10 in. plank set on edge. The planks are held in place by iron rods imbedded in the concrete bottom. The channel is 4 ft. wide at the inlet end and gradually reduces in width to 1 ft. at the distant end. The flow is diverted on the beds through openings made in the sides of the channel. A reduction in width is made at each of the openings and the plank in the sides overlap at the latter. The outer plank are beveled on the inner side. A space 6 in. wide is left at the overlapping ends of the plank on each side. The inner planks are also both hinged 1 ft. from the end so the width of the openings on each side may be increased, the entrance of the channel beyond the opening being obstructed at the same time. The hinged ends are held in the desired position by an iron strap on the top of each of them, the straps having holes in them in which keys that fit in holes in the top of the outer planks are placed. A 3 x 4 ft. concrete apron is placed on the surface of the bed on each side of the openings and at the end of the channel to prevent scouring.

The underdrainage consists of a single line of 6 or 8 in. sewer pipe under each bed. These pipes are laid with open joints, 6 to 10 ft. below the surface. These lateral drains connect with main drains which join in a 12 in. sewer pipe leading to the creek. It is not believed, however, that anything like the quantity of water pumped on the beds will reach these underdrains.

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ABOUT THE PRINCIPAL AUTHOR

Tom Davey has worked as a journalist in England, Australia and Canada, with experience in newspapers, magazines, radio and television. After working as a reporter, feature writer and editor, for various media, he became Publications and Science Editor at the University of Toronto's Institute for Environmental Studies. While there, he launched and edited IES Bulletin and Research News and was guest lecturer on communications and media effectiveness for several graduate courses. He left to form Davcom Communications and is frequently retained by the university as a communications consultant and lecturer. Currently, he is Senior Consulting Editor of Water & Pollution Control magazine on a contract basis. His professional work has ranged from working as a legislative reporter for the Australian Broadcasting Commission, to being editor of a national four-colour magazine in London, England, dealing with the scientific and industrial aspects of Energy Management. He has been a frequent consultant on publications or scientific reports for government agencies, consultants in the private sector, and for the University of Toronto.